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The Efficiency of Dynamos.

THE question of dynamo efficiency just at present has perhaps less keen general interest than a few years ago, for, to a certain extent, dynamo manufacture has become crystallized, objectionable forms have been discarded, and altogether most of the machines actually on the market are of a pretty satisfactory efficiency. Mr. Kapp's notes on the subject of the determination of efficiency, published elsewhere in our columns, review the subject very thoroughly and point out some of the niceties of measurement that are absolutely necessary in the technical work of to-day. His examination of the sources of loss in dynamos and the source of errors as affecting final efficiency are well worth careful reading. Just now, however, the principal interest in efficiency tests centres around alternating machinery, to which many of the same testing methods that are found satisfactory for direct current dynamos will readily apply. In this latter case, however, the use of purely electrical methods, such as suggested by Mr. Kapp, is not particularly advantageous, inasmuch as the measurement of the energy in an alternating current is sometimes rather more difficult than the direct measurement of the mechanical power required, for instance, to drive the dynamo.

Experiments in High Potential Induction.

A VERY striking paper by Prof. Elihu Thomson, which we publish this week, gives the results of some most interesting experiments on induction by very high potential discharges. Prof. Thomson was led to these experiments by the fact, of which he had long been convinced, that occasionally electric lines are severely affected by discharges of lightning, not upon the wire, but from cloud to cloud. The experiments were primarily intended to throw light on the subject of a proper protective apparatus to guard electric machinery from just such inductive discharges. The outcome of this investigation was the exceedingly beautiful series of results which are detailed in the present paper. They are no less striking in their way than those experiments of Mr. Tesla which have awakened so much interest abroad. Prof. Thomson's method is a very convenient one for getting sparks of enormous length and power heretofore only obtained by the use of exceedingly expensive and delicate apparatus. In the recent direction that electrical work has taken the ability to command readily very high potentials will prove invaluable to the experimenter, for he is thereby enabled to work out with 50,000 or 100,000 volts, on a practical scale, tests, both methods and results of which depend on the use of enormous potentials. Meanwhile Prof. Thomson has not only found out a great many curious and interesting things that he was looking for, but has proved the startling effects of electro-dynamic induction that result from an ordinary lightning flash.

From Niagara to Chicago.

ELSEWHERE in our columns is treated again the subject of the transmission of power from Niagara Falls to Chicago at the time of the Exposition. This time it is, electrically speaking, from a point of view diametrically opposite to anything that has heretofore been proposed—in fact, it is nothing less than the transmission of power by continuous currents of enormous voltages. There is nothing especially novel about the principle, which has been proposed, and, in fact, tried under various circumstances. The present proposition is only striking on account of its magnitude. Transmission of power by continuous currents of very high pressure has the disadvantage of requiring somewhat complex machines. It is quite possible to build continuous current generators that will operate successfully up to three or four, or even five, thousand volts, with results that are uniformly good. Conceive, now, half a dozen of these machines connected in series as generators, with armatures so connected as to compel them to move practically in unison. Now, let the resulting current be received on a similar combination and the problem would seem to be solved; theoretically, there is no difficulty about it; practically, the machines run together harmoniously enough, and the insulation of the armatures has proved itself able—at least in experimental service—to stand the strain of unusually high voltages. Nevertheless, this sort of power transmission, on so large a scale as that proposed, necessitates dealing with much higher voltages than are familiar in continuous current practice, and the installation would have to be, to a certain extent, experimental. It could probably be made to operate successfully, but constitutes a rather formidable engineering task; one, too, that does not seemingly offer any special advantages over alternating current transmission for such purposes.

The Electric Light Convention.

THE coming convention of the National Electric Light Association at Buffalo will be, on the whole, the most business-like that the organization has yet had. There will be apparently somewhat less junketing and a great deal more business transacted than has been the custom. Especially will the convention be conspicuous by the absence of the elaborate displays of promiscuous apparatus that have served to distract the time and attention of the delegates a good many times in the past. The supply element will undoubtedly be out in force, but it will not waste time and money attending to exhibits; on the contrary, it is far more likely to go on the still hunt for the victims with an ulster pocket full of switches. This particular turn the present convention has taken is largely due to the energies of President Huntley, who feels that the delegates are there for their mutual improvement, and not to go on an agglomerated lark—at least until after the convention is over. There will probably be three sessions a day, and plenty to think about at each session. The list of papers is apparently a valuable one, intended to include every detail of electric light operation from the coal pile to the final reckoning when dividends must be paid. The boiler, engine, dynamo, switchboard, the wiring—overhead and underground—all come in for a share of attention, and in addition there will be one evening devoted to the discussion of the transmission of power, in which many central station managers now have to take a hand. This will be a polygonal discussion, in which Messrs. Carl Hering, William Stanley, Jr.; H. Ward Leonard, and very likely others will participate. As these three gentlemen represent three phases of belief in power transmission differing considerably more than 120 degrees from each other, we may expect the whole subject to be gone over thoroughly and to the great advantage of the audience. A large attendance appears to be already assured, and everything indicates that the gathering will be a most agreeable and useful one.

The Trolley in Chicago.

FROM present appearances it would seem that there is a strong probability of a trolley system appearing on certain of the crosstown lines in Chicago before the opening of the Exposition. The South Side will probably be the scene of the innovation. The company that now operates the street car system in that portion of the city seems to be fully alive to the fact that it can save money by abandoning the horse, and equally well understands that it would be flying in the face of its pocketbook to attempt to cable lines on which the traffic is not particularly heavy; hence a kindly and sympathetic feeling toward the trolley. There is one advantage about the adoption of the overhead system in Chicago—there will be comparatively little talk about its alleged horrible dangers, because the inhabitants of the Windy City are, in the first place, too progressive to scare readily, and, in the second place, they have become inured to every sort of horror that a badly managed street car line can afford. A car can run over and kill two or three people in the most crowded part of the city without occasioning any more than a 10-line local in the next morning's papers. Being accustomed to these real accidents they are not likely to be much perturbed in spirit by the alleged dangers that surround the trolley. The cable system has at least one marked advantage; it reconciles the public to any sort of change—for any change is in the direction of greater safety. And, speaking of the alleged bad character of overhead lines, our readers may glance with profit at an interview with Mr. O. T. Crosby, recently published in the New York *Sun*, and given in our columns. It puts the facts of the case in a straightforward, clear and concise fashion that will furnish food for considerable reflection. With the trolley in Boston, Brooklyn and Chicago, it is not too much to hope that some time in the course of the next quarter of a century New York may tire of the horse car, sicken of the long list of accidents that follow the introduction of the cable, and so finally turn for refuge to the system it has so long and bitterly abused.

The Utilization of Waste Steam.

THE utilization of waste products is of itself a subject of intense interest both scientifically and economically. Who is not familiar with the marvelous products that used to go to waste around gas houses, and what electrician of later days has not made more or less to his sorrow the acquaintance of the primary battery that is to make well-known chemicals at so low a rate that the electricity itself can be fairly considered as a by-product obtained for nothing. But there does exist in the production of electricity one case, which Mr. Hering has pointed out in a brief article in our columns this week, in which steam that would otherwise be unemployed is used to good profit for the purpose of heating neighboring buildings. As is a familiar fact to every one, steam heating is done at low pressure, except in rare instances, so low as to produce no leakage to speak of—even under ordinary conditions of plumbers' incompetency. This pressure is only a very few pounds in actual figures, so little that the exhaust steam from a high pressure engine is quite capable of serving the purpose very efficiently. Of course where water for condensation is available condensing engines are generally put into service, and what would otherwise be the exhaust steam put to useful work in the engine. When, however, as sometimes is the case, conditions forbid this, as, for example, in the Twenty-sixth street station in New York City, where some very large engines have to be worked non-condensing on account of lack of water supply, the waste steam can be turned to account for heating the station if necessary, and has been made a source of profit by heating buildings in the vicinity. Central station managers are gradually becoming aware of the importance of this particular by-product, and we are happy to say that there are now a good many excellent examples of heating by waste steam, and it is found not only convenient, but profitable. Mr. Hering's paper gives a good idea of what can be done in this direction and of some results of actual circumstances.

A Sad Case of Neglect.

WHAT has become of our talented and ubiquitous friend Ananias Fakeson? Why was he not around to write up the details of the Hotel Royal fire? Is he dead, or is it simply that, like the Hon. Joseph Mulhatton, he is hibernating, meditating some splendid flight of the imagination for the early springtime. Never was a more beautiful opportunity for the romantic offices of our friend Ananias than that same Hotel Royal fire. Is it possible that a building was consumed and very nearly 20 lives lost without even a single voice being lifted to charge the calamity to the deadly wire? Is there not somewhere within a block, or a block and a half, or two blocks, of that fated corner of 40th street and Sixth avenue a pole on which one of these hated objects swings? If so, how did it happen that the origin of the conflagration was not traced to an unused electric light wire from which all current had been cut off during the previous two days, or to a telephone wire long since dead to electric current, or—if everything else failed—to a wire clothes line on the next adjacent shed roof? We used to feel a calm and delicious confidence that whenever there was great loss of life and property by fire four or five people could be found willing to make oath that balls of blue flame had run into the building along the electric wires from at least eight different directions. But now what can we think! Has reportorial imagination fallen to such low estate that it cannot rejuvenate these time-worn yarns, or is it possible—and we drop this suggestion merely as the wildest kind of hypothesis—that the public would like a little more plausible explanation than the much burdened electric wire. The late electrical execution was remarkable in that it did not develop anywhere nearly the usual crop of savage jeremiads replete with pollysyllabic adjectives and garnished with blood-and-thunder head lines. Can it be that the novelty of the deadly wire has at last so worn off that even the most impecunious penny-a-liner refuses to court the editorial blue pencil by alluding to it?

Latest Foreign Electrical News.

(By Cable from Our Own Correspondent.)

London, Feb. 15, 1891.—The report of the Bradford municipal electtic light station just made shows that the net profit of £971 was the result of the last half-year's business.

According to the Parliamentary estimates for the construction of London electric railways, which have just been published, the average total cost per mile for the double tunnel system is given as £330,000, while the actual cost of tunneling is placed at about £125,000.

Quite a demonstration was made at the Crystal Palace Electrical Exposition a few evenings ago on the occasion of the visit of the Lord Mayor of London. After the examination of the various displays of electrical apparatus a banquet was spread for the guests, among whom was Mr. Nikola Tesla. After the dinner Mr. Tesla made a brief speech.

The Wentz Telegraph Line Adjuster.

BY WM. A. ROSENBAUM.

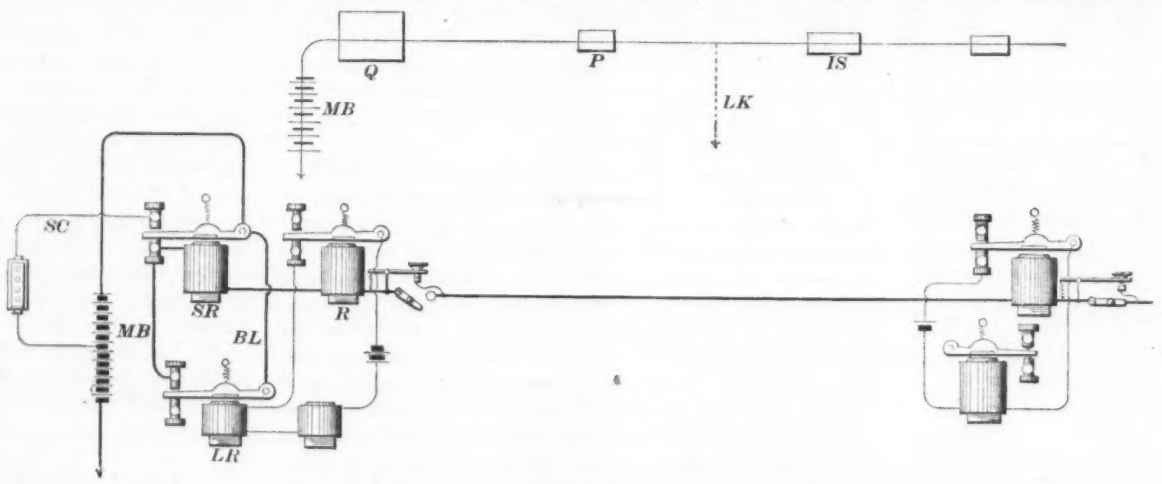
Articles have appeared recently in some of the electrical journals relating to the question of the insulation of telegraph lines. The discussion has been principally on the substitution of porcelain insulators for glass insulators. Without discussing in detail the merits of the two insulators, it is apparent at once that the expense of making the change on the lines now in use would be very great and that a cheaper substitute which will accomplish the same result is desirable, especially so if it may be applied and put into use in a comparatively short time.

The Delany line adjuster is perhaps the best known and when it made its appearance it was thought it would meet the conditions and greatly improve the working of telegraph lines in wet weather. Its principle of operation was to open the line at both terminal stations *for an instant only* every time a key opened, thus cutting the entire battery off from both ends of the line and compelling the relays at the intermediate offices to respond. The fault in this operation was the fact that the device which cut off the batteries only did so for an instant, and its action did not correspond to the movements of the key, the result being that if the key was held open until the batteries were cut in a "kick" would occur in the intermediate relay, caused by the escaping current, and thus confuse the signal. The adjuster would probably work better if it held the batteries off as long as the key is open.

The description of a line adjuster which has recently appeared will no doubt be interesting in this connection. It is designed to do exactly what the Delany adjuster fails to do satisfactorily and to accomplish this object with a much similar and cheaper apparatus. The invention was made by Mr. William F. Wentz, of Newark, N. J., and has been recently patented by him in the United States and foreign countries. In the Wentz adjuster the instantaneous cutting off of the batteries is followed by a reduction of the battery instead of by full battery, so that the escape is correspondingly reduced and does not affect the relays. For a description of the Wentz adjuster, the accompanying cut of the apparatus and circuits is referred to. At each terminal station there is located in the main circuit in addition to the ordinary relay, a second relay *S R*, wound to be more sensitive than the ordinary relays. The main circuit after it leaves this relay goes to its front stop and normally through its armature to the main battery. Branch circuit *B L* connects the armature of the sensitive relay with its front stop through the armature of a local relay *L R*. in the local circuit with the sounder. The back stop of the sensitive relay is connected by wire *S C* with the main battery in such a way that when the armature of the sensitive relay is against its back stop a portion of the main battery is short circuited through a resistance. Assuming there is a heavy escape on the line, an operator now opens his key, and immediately the sensitive relays at the terminal stations respond, because they are always kept in adjustment. While the armature is traveling to its back stop the entire battery is cut off and all of the relays respond. When the ordinary relays at the terminal stations respond, the relays *L R* also respond and close the branch circuits *B L*. thus completing the main circuit through the sensitive relays, but when the armatures of the sensitive relays reach their back stops the short circuit *SC* is completed, and the electromotive force of the main battery is thereby so greatly reduced that the current which may find a path through the escapes on the line will be comparatively smaller than if the full electromotive force of the battery was presented to the line; hence, with a proper adjustment of the battery shunts at the terminal stations the current which may still flow over portions of the line when a key is open will be so small as not to affect the ordinary relays, and their armatures must in consequence remain against the back stops. When the key is closed the relay *S R*, being sensitive enough to respond to the reduced battery then presented to line, attracts its armature and immediately breaks the shunt circuit and puts the full battery to line, thus compelling all of the ordinary relays to respond. It will be observed that the function of the branch *B L* is to enable the operator to continue signaling by providing a circuit through the sensitive relay for the reduced battery.

It will thus be observed that when a key opens the Wentz apparatus cuts off the entire battery in the same manner as the Delany, but it goes beyond the Delany in that it immediately reduces the electromotive force of the main battery, thereby holding the armature of the intermediate relays against their back stops and preventing the objectionable "kick."

Mr. Wentz has designed several different forms of apparatus for carrying out the principle herein set forth, some of which are perhaps preferable to the form described. He also contemplates reducing the battery in various ways, such as by inserting resistance, cutting in opposing battery, and so forth, all of which, with the principle involved, we understand to be protected by his patents.



THE WENTZ TELEGRAPH LINE ADJUSTER.

The Programme of the Buffalo Convention.

The programme for the coming convention of the National Electric Light Association as issued by the secretary is as follows:

Tuesday, Feb. 23.—Meeting of the Executive Committee at 9 A. M. in the parlor of the Iroquois Hotel; morning meeting, 10.30 o'clock, at the Library Building; address of welcome by Hon. Charles F. Bishop, Mayor of Buffalo; address of President Huntley; report of Committee on Underground Conduits and Conductors, M. J. Francisco, chairman.

Afternoon session, at 2 o'clock. Report of Committee on Safe Wiring, M. D. Law, chairman; report of Committee World's Columbian Fair, B. F. Sunny, chairman; paper by Richard Hammond.

Evening session, at 8 o'clock. Paper by Carl Hering on "The Transmission of Power," followed by discussion by William Stanley, Jr., L. B. Stillwell, H. Ward Leonard, Elihu Thomson and others.

Wednesday, Feb. 24. at 10 o'clock.—Paper by D. Ashworth, "The Allied Powers;" paper by Wm. Stanley, Jr., "The Alternating Current Motor;" paper by Erastus Wiman, "Electric Lighting from a Financial Standpoint."

Afternoon session, at 2:30 o'clock. Paper by M. C. Sullivan, "Switchboards, Their Safety and Operation;" paper by Chas. A. Schieren, "From the Tannery to the Dynamo;" paper by Allen R. Foote, "Municipal Franchises for Quasi-Public Corporations."

Thursday, Feb. 25, at 10 o'clock.—Paper by E. F. Peck, "Overhead Construction;" paper by E. A. Leslie, "The Operation of High Tension Currents Underground;" paper by J. B. Craven, "Underground Construction of Buffalo Railway Company."

Afternoon session as 2:30 o'clock. Paper by L. B. Stillwell; report of Secretary and Treasurer; report from Executive Committee; election of officers.

In addition to what was given in our columns last week the following letter has been sent out by Mr. C. O. Baker, Jr., of the transportation committee:

"A special vestibuled train, composed of parlor, buffet and dining cars, will leave Grand Central Station, Forty-second street, New York, 11 A. M., Monday, 22d inst., and will make the following stops to take on delegates: Albany, 2:45 P. M. (Boston delegation joins); Utica, 5:25 P. M; Syracuse, 7:00 P. M.; Rochester, 9:24 P. M.; Buffalo, 10:45 P. M. Seat checks for this train can be procured from undersigned at $2.00 each. Railroad tickets can be obtained from any of the New York Central Railroad offices. (Be sure you get a certificate when purchasing ticket.) Tickets will also be on sale at the Electric Club Saturday afternoon and evening, Feb. 20, and, for greater convenience, orders acceptable for tickets and certificates on the train can be obtained at this office upon payment of outbound fare, $9.25 each. Please make checks payable to C. O. Baker, Jr."

Very respectfully, C. O. Baker, Jr.

Induction by High Potential Discharges.

BY ELIHU THOMSON.

It is well known that electric lines are strongly affected by induction during thunderstorms, and it would naturally be inferred that a line in a direction parallel to the flash would receive the strongest inductive influence, and that the induction would not necessarily be static induction, but currents would be set up by dynamic induction, complicated in many cases by static inductive actions occurring at the same time. What are known as "return strokes" in lightning flashes, according to this view, may be nothing more nor less than parallel induced discharges along fairly good conducting paths, and it is possible that in the neighborhood of a lightning flash such induction may be of a very intense character.

These considerations led to my making the experiment of inducing, by a Leyden jar discharge, passed through a single turn of insulated wire, a discharge in a ring shaped vacuum tube placed alongside, which was found to illuminate the vacuum. Similar experiments had been made and published by Prof. J. J. Thomson.

In working to devise a means for the protection of electrical apparatus from the effects of such induced discharges of lightning it occurred to the writer to employ the inductive effects of the discharges to counteract, as far as possible, the effects of such discharges, or, as it were, to interpose a barrier between the discharges and the apparatus to be protected. This gave rise to a lightning discharge protector or lightning arrester, the principle of which is shown in the accompanying figure. Let *L* be a line leading from a dynamo or other electrical apparatus, and subject to induction from lightning discharges, or subject to lightning discharges themselves, as in a railway trolley line. Let *D* represent a dynamo with one terminal grounded and the other connected to line. In such a case were there no provision for protecting the dynamo *D* from a lightning discharge it would be in danger of injury in case of induction occurring along the line, or in case of a flash reaching the line. To avoid this I place between the dynamo and the line a sort of induction coil which consists of a double coil, each coil being made of a few turns of coarse wire highly insulated from each other. One of the coils may be wound upon the outside of a glass cylinder and the other coil may be wound in the interior thereof. Both are connected to line at one end, as shown, and one or both are connected to earth through the discharge plates of a lightning arrester *A* provided with an arc rupturing device, such as a magnet to blow out the arc in case the potential of the dynamo is high enough to maintain such an arc. The coil in the dynamo circuit has been found to need a few more turns than that in the earth circuit, and the direction of winding in the two coils is such that they are opposed in their inductions, or that a discharge passing from line to earth through one of the coils tends to induce a discharge in a direction toward the line in the other coil, or the coil in the dynamo circuit.

The manner of experimenting to determine the relation of the coils was substantially as follows: A double coil was made in which the inner turns were about 12 and the outer turns 20. These were kept separate from each other, and a branch wire taken from the line and slid from point to point on the outer wire enabled the effective length of the same to be adjusted. The inner coil was connected through a small spark gap, as at *A*, to the outer coating of a Leyden jar, while the wire *L* was brought near the pole of the jar, which was continually being changed from a Toepler-Holtz machine. The discharge in passing from the knob of the jar to the wire *L*, representing the line, passed by the inner coil. When a certain length of the outer coil was employed only a very short or almost imperceptible spark was obtainable at *a*. If the balance of the turns were disturbed by including more or less than the proper number of the outer turns not only did a vigorous spark occur, but the gap at *a* could be quite considerably extended, in accordance with the amount of departure taken from the proper number of turns required to produce the balance. This experiment indicates that it is possible to make a selective path for the Leyden jar discharge and to have, as in Fig. 1, a structure so proportioned that the discharges reaching line will pass to earth without tending to go through the circuit of the dynamo *D*. The action is apparently due to a balance of electromotive forces, such that the discharge which tends to pass from the line in going to earth induces in the coil connected to the dynamo a counter electromotive force which nearly wipes out the potential of the discharge before it reaches the dynamo. This balance of inductive effects is certainly very striking, and once obtained it is disturbed, as in the experiments, by changing the relative lengths of the coils in inductive relation through so small an amount as an inch or two.

It may be mentioned here that some curious effects of spark were obtained in these experiments. When a dis-

turbance of the balance exists and a spark is obtained at *a*, the character of the spark is different from that of the Leyden jar discharge. It appears to be less luminous, the noise less sharp and its color would indicate a greater power of volatizing metal and perhaps a greater duration. It is in part no doubt due to a current local to the coils in series with one another.

Another curious effect was the production of T shaped and Y shaped sparks, or three branched sparks, such as are shown in Figs. 3, 4 and 5.

These were obtained by separating the electrodes at *A*, an inch and a half or thereabouts, and bringing the third electrode from the outer coil to the position shown in Fig.

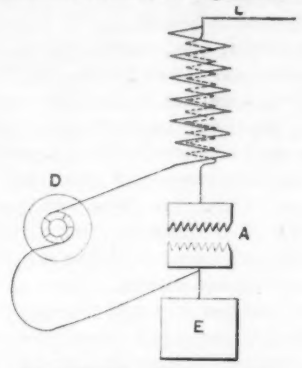


FIG. 1.—PROF. THOMSON'S EXPERIMENTS ON ELECTRIC DISCHARGES.

3. The discharges were now obtained as before from the charged jar. In this case the discharge appears to split and unite in air, producing the curious shaped sparks shown. It would seem that to obtain these effects, particularly the sparks which were three branched from a common point in the centre between the discharge electrodes, the dielectric air must break down simultaneously between the three electrodes. It would easily explain the T shapes to assume the straight part above to form first, and the cross or transverse spark to strike from the side of this spark to the third electrode.

The induction effects obtained with apparatus described soon led the writer to reason that the passage of heavy condenser charges through a coarse wire primary coil of few turns might be made to induce in a finer coil of more turns wound parallel thereto discharges of much higher potential and less current. In this case the Ruhmkorff coil would, as it were, have its primary subjected to the oscillations of a condenser discharge of high potential, instead of low potential battery discharges raised in potential by the condenser and interrupter.

On trying the experiment with a coarse, heavily insulated wire coil of ten turns, inclosed in a glass tube, without any iron core, and with a secondary of one layer of fine silk covered wire outside the glass, it was found that the passage of the Leyden jar discharges of about half an inch spark in the coarse coil would give rise to such high inductive effects in the secondary as to spark from turn to turn in a single layer. By immersing the whole in a jar containing insulating oil, however, the insulation of the turns was better kept, and sparks of two or three inches were obtained between the terminals of the secondary at every discharge of the jar. The glass tube used was about two inches in diameter and about five inches long. There were about 120 turns in the secondary layer. The induction

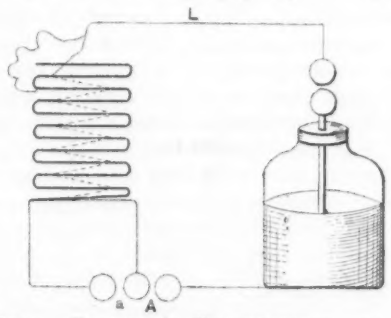


FIG. 2.—PROF. THOMSON'S EXPERIMENTS ON ELECTRIC DISCHARGES.

must have been at least as high as from 100 to 150 volts to the inch of wire. It was soon found that the glass tubes one-eighth of an inch thick were frequently punctured under the oil, and that the spark of the jar could not be unduly lengthened without producing discharges under the oil, or between turns of the secondary.

The sparks from the secondary were peculiar in that they appeared to be prolonged and quite like those of a Ruhmkorff coil worked in the ordinary way, but with small condensing surfaces on each terminal of the secondary.

Arrangements were now made to obtain frequent condenser discharges at high potential, and to carry on the experiments on a much larger scale. The results have shown that it is now in our power to obtain torrents of long sparks, and that this may be done without any very great expense for apparatus, the expense being very great in the case of the large Ruhmkorff coils hitherto made. Sparks of two or three feet long will, I think, be readily obtainable. The sparks are like those obtainable from small jars, and if the terminals be connected to jars in the same way as the condensers are attached to a Holtz machine, the thickness of the sparks can be increased at a sacrifice of length.

I will now describe the apparatus I use. This will give a torrent of sparks of 7 to 8 inches in length making a loud roaring sound, and the length of spark seems limited only by the capacity of the secondary coil to maintain the insulation. This will be improved in the next construction.

In Fig. 6 is a view of the apparatus used. *A* is a large induction coil or transformer capable of using in its primary ordinary alternating lighting currents of 50 to 100 volts and transforming up to 10,000 to 12,000 volts alternating. So used it will spark over one-half inch to one inch between its terminals and give the uprising thin arc now well known. A blast of air blown on such an arc changes it into a beautiful pale purple flame. A condenser *B*, the capacity of which can be changed, is connected to receive the current from the secondary of *A*. The spark or arc with moderate condensing capacity is not much changed unless a blast of air be blown upon it. In this latter case it becomes a most beautiful electrical phenomenon. It becomes a mass of flame filled with fine and thick shreds representing the condenser discharges, a gorgeous network of electric fire changing with any change of the pressure or direction of the air blast. Sometimes, as on breaking the primary circuit, the oscillations of charge and discharge are seen as minute parallel lines or sparks on the borders of the flame joining the terminals. With greater condensing surface the discharge between terminals becomes more thick and white even without the blast, and when a forcible air jet is turned on it roars very loudly. At *C* is a second and peculiar transformer, the primary of which is an open helix of but a few turns as 15 or 20 convolutions of heavily insulated line wire about four or five inches in diameter. This is surrounded by a thick glass cylinder upon which has been wound say 150 turns of fine silk covered wire in one layer with a silk thread between the turns so as to cause the turns to be well insulated laterally. This simple induction coil is now immersed in a jar of heavy oil and the terminals on leaving the oil kept as far apart as

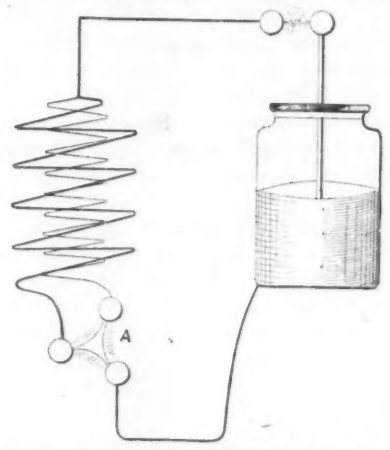
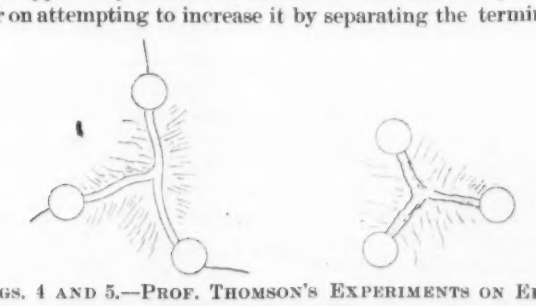


FIG. 3.—PROF. THOMSON'S EXPERIMENTS ON ELECTRIC DISCHARGES.

possible and surrounded by glass tubes. The terminals of the coarse and short primary are connected in circuit with the discharge balls upon which the jet of air plays at *J*. The finer secondary terminals are connected to discharge terminals as at *D* for obtaining the spark. On passing the alternating currents in the primary of *A* and adjusting the spark gap and jet at *J* as well as the distance between the discharge terminals at *D*, it is easy to obtain sparks of seven to eight inches in a perfect torrent at *D*, while sparks of one-fourth inch are passing at *J*.

In fact coil *A* and condenser jars *B* constitute the source of very rapid electric oscillations and correspond to the primary battery and condenser of a Ruhmkorff coil, while the air jet and spark gap at *J* bear a similar relation to the interrupter.

The discharges obtained at *D* represent, it would appear, at least 150,000 volts in potential or about a thousand volts to each turn of the secondary. The potential may be higher, for we have no data of spark length at such high pressures. It should be mentioned that the limit of spark was apparently that of the insulation of the secondary turns, for on attempting to increase it by separating the terminals



FIGS. 4 AND 5.—PROF. THOMSON'S EXPERIMENTS ON ELECTRIC DISCHARGES.

at *D* to over eight inches the sparks jumped in the jar of oil and could be seen passing under the oil from the secondary to the primary wires. Were it not for the required insulation between the turns of the fine wire secondary of *C*, they could be wound in one layer so as not to cover more than two or three inches of the glass cylinder, and could be made to give out sparks of a foot or more in length. The volts per inch of wire obtained in these experiments are extraordinary, and it is quite certain that the limit will depend on the insulation. We are now possessed of the means for obtaining artificial lightning in a steady stream, and can experiment at will with extremely high voltages. The advantages of oil insulation are emphasized by these experiments, and although sparks frequently passed under the oil the insulation is renewed at once.

It is necessary that the coil *C* be sunk well below the surface of the oil as otherwise the discharges will perforate the oil layer at each end and pass over the surface. It is curious to note the agitation of the oil over the coil when the apparatus is in action and the coil is not deeply immersed and yet sufficiently so to prevent discharge. A curious discharge without electrodes is obtained by providing each terminal of the secondary layer *C* with a metal plate which the oil just covers, the plates being parallel to the oil surface, Figs. 7 and 8. Great agitation of the oil over the plates ensues and sparks pass over the surface of the oil and spread over the surface just above the plates.

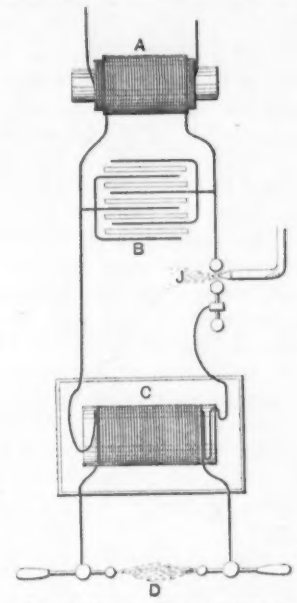
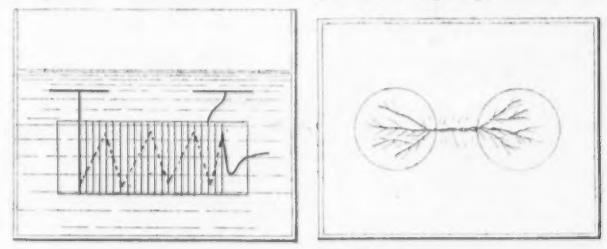


FIG. 6.—PROF. THOMSON'S EXPERIMENTS ON ELECTRIC DISCHARGES.

If the oil layer be too thin it is perforated by discharges passing from plate to plate and oil is scattered. Geissler tubes are lighted in the vicinity of the coil, outside the jar or near the terminals, an action long well known in the case in the working of Ruhmkorff coils of considerable power. The frequency of the alternations used was 125 or 250 alternations per second. By raising the alternations the spark torrent will be more continuous. On the completion of still more powerful and perfectly insulated apparatus the effects will doubtless be greatly enhanced.

The experiments demonstrate that lightning discharges, aside from electrostatic effects, may be the source of most vigorous electrodynamic inductions, and that high potential discharges may result. The bearing of this on a "return stroke" has already been mentioned.

It may also be pointed out that in the electrodynamic inductions set up we have a means for the study of the rate of oscillation, potential and current of lightning discharges which are now but little understood. It is too much to assume that all such discharges take the oscillatory character of Leyden jar discharges, and it would be useful to distinguish between rates and characters of discharge. The writer remembers that during a storm a few years ago he noticed a ringing or humming sound accompanying a not very distant flash of lightning. The sound was remarkably clear and almost musical. Could it have recorded the oscillations of a discharge in which the capacity and self induction were such as to give the oscillations a defined rate within the ordinary range of pitch of musical sounds? It is an observation which the writer takes the present occasion to record, as a strong impression was



FIGS. 7 AND 8.—PROF. THOMSON'S EXPERIMENTS ON ELECTRIC DISCHARGES.

made on him on account of the loud, clear ringing tone which followed the flash.

Proposed High Speed Electric Railway from Chicago to St. Louis.

Had the bold project to unite the cities of Chicago and St. Louis by an electric railway that would transport its passengers at the rate of 100 miles an hour been proposed by Chicago capitalists, it would have been recognized at once as an attempt to make St. Louis one of the most accessible suburbs of the city by the lake. The scheme, however, has been proposed by St. Louis men and must therefore be regarded as a tardy recognition of the advantages to be secured by "living nearer" Chicago's city limits. A prospectus of the proposed line and its equipment which has just been issued gives some additional information concerning this projected long distance electric railway. Perhaps the most striking thing about the prospectus is the confident style in which its author constructs his proposed line in that characteristic English fashion by the use of a straight edge and pencil, and the highly entertaining way in which the ideal possibilities of such a line as the one proposed are set forth. Fig. 1 shows the map of the proposed line across the State of Illinois through what is perhaps the

finest agricultural section of the United States. It will be seen that the line "as the bird flies" between the cities is about midway between the two main steam highways, the Chicago & Alton and the Wabash railroads. The city of Wilmington in the rich coal mining fields is the only large one directly in the route. The important trade centres of Springfield, Bloomington, Joliet and Decatur are considered of less importance than a direct line and are given branch lines from the nearest point on the main thoroughfare.

The company's statement of its intentions says that it has been organized "for the purpose of constructing, maintaining and operating a complete electric railway system between the cities of Chicago and St. Louis, with suitable and necessary spurs or branches connecting with the towns and cities along said road, for the accomodation of 'local' and 'through' passenger and high-class freight, express and mail traffic; and for the further purpose of supplying citizens and cities along the route of the road with light, heat and power for state, county, municipal, domestic, farming, manufacturing and other purposes."

According to the plans of the general manager, Dr. Wellington Adams, the proposed road will be operated from one central station, located at the mouth of a coal mine somewhere near the centre of the road. The railway company will operate this mine by means of electric mining locomotives, electric drills, electric cutters and electric lights, which will greatly cheapen the present cost of the ordinary system of mining coal. The possibility and economy of this method of mining has already been established beyond dispute. The company will sell the good coal that it mines at a handsome profit, and use only the waste dust or slack to run the engines which develop the power for operating the mine and road, in connection with its distributing system of light and power for consumers along the line of the road. At the present time, such dust and slack is not only valueless, but has to be hauled away at the expense of the mining company. The road will be divided up into twenty-five sections of ten miles each, which will constitute a complete block system, making it impossible for any two cars to run at a high speed upon any single section at the same time, thus making collisions impossible. There will be a complete block signaling system by means of incandescent electric lights, with telephonic communication between cars upon the same section, whether running or standing still. The road will be illuminated by incandescent electric lamps for one mile ahead and one mile behind every car while running. It will be built in a practically straight line, and as far as possible will avoid grade crossings of other roads. At all grade crossings, whether wagon or railroad, a red electric light will be displayed and an electric bell rung for two minutes before it is time for the train to pass. It is intended to ultimately construct four tracks, two outside tracks for local traffic and high class freight, while the two inner tracks will be used exclusively for through passenger traffic, mail and high class express. The through cars will not stop anywhere between the two terminal cities between which they run. Spurs or branches will be run, connecting the large cities along the line of the road with the main through tracks, and from these cities individual through cars will be run to and from the cities of St. Louis and Chicago without stop. Ultimately a street will be run along the sides of these tracks, along which dwelling houses and stores will be built. On both sides of these avenues the land will, ultimately, be laid out in building lots 100 feet front by 200 feet deep, giving an area of half an acre to each lot. These lots will be bought by people from town seeking the healthy air of the country and pleasant homes within quick and cleanly access of the city. Back of them they will have the open farm lands, and in front of them the boulevard with the electric railway, telephone and electric light, practically uniting Washington avenue, St. Louis, with Michigan avenue Chicago, by one grand electric highway or boulevard, along which the farmer may secure electric light and power for pumping, plowing thrashing, chopping and mixing fodder, shelling and grinding corn, and harvesting at night in cases of emergency; and the rural resident may secure electric lights for the illumination of his dwelling, electricity for heating and cooking, and electric power for domestic purposes.

Either of the three routes which this road proposes to take betweeen St. Louis and Chicago, it is stated, will be at least 33 miles shorter than the shortest of the existing steam routes. The standard schedule time of all through cars will be 100 miles per hour. The trip from St. Louis to Chicago, can, therefore, be made in from two and a half to three hours. It will be unnecessary to travel at night, therefore no through passenger cars will be run after 9 o'clock P. M., the tracks being reserved at night for high-class freight, express and mail. This does away with the necessity of running Pullman cars, and the expense to the company attendant thereon, as well as to the traveling public. No man will care about traveling at night when he can travel in the day time over a cleanly road which will land him so quickly at his destination. Farmers along the line of the road can build cheap switches with light rails, which will enable cars to be run directly to the doors of their barns and granaries, to facilitate the transportation of the products of their land, thus rendering them largely independent of the condition of the ordinary wagon roads, which, by the way, have become very poor through neglect since the inauguration of the railroad system. Thus will the vast markets of St. Louis and Chicago be practically at the door of every farmer throughout this district, for the sale of his perishable produce.

The character of the electric car that will be run upon this proposed electric road is shown in Fig. 2. It is a long, low, compact, light, but strong car, having

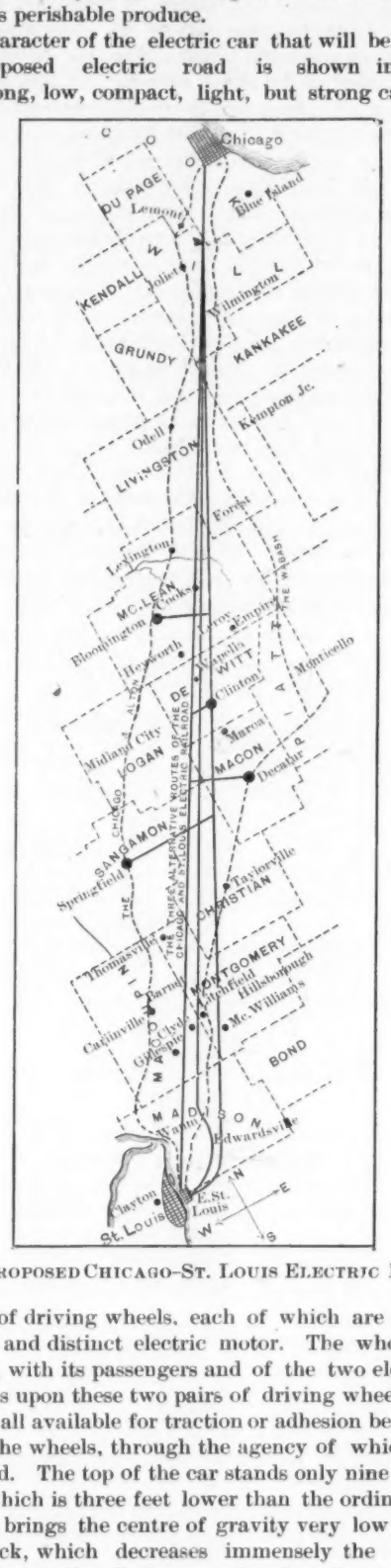


FIG. 1.—PROPOSED CHICAGO-ST. LOUIS ELECTRIC RAILWAY.

two pairs of driving wheels, each of which are driven by a separate and distinct electric motor. The whole weight of the car, with its passengers and of the two electric motors, comes upon these two pairs of driving wheels, and is, therefore, all available for traction or adhesion between the rails and the wheels, through the agency of which the car is propelled. The top of the car stands only nine feet from the rail, which is three feet lower than the ordinary street car. This brings the centre of gravity very low and near to the track, which decreases immensely the danger of jumping the track. It has a wedge-shaped nose or front for cutting the air, which has the effect of decreasing the air resistance (a most important factor in high speed locomotion) and of helping to keep the car down upon the track. The motor man stands immediately back of this wedge-

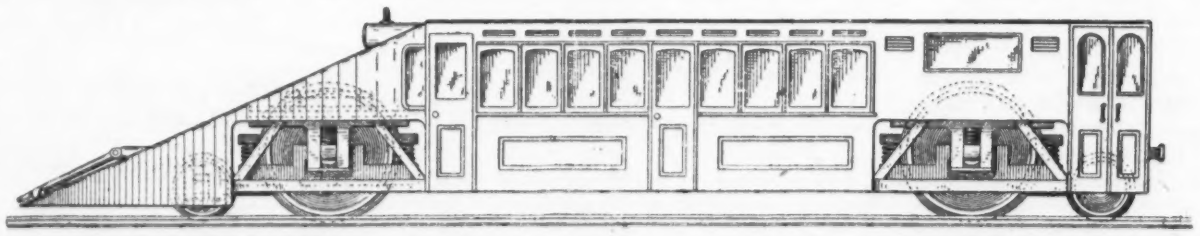


FIG. 2.—PROPOSED CAR OF THE CHICAGO-ST. LOUIS ELECTRIC RAILWAY.

shaped front, and between his department and the rear wheels is the compartment for the accommodation of passengers. In the rear of this is a separate compartment for mail and high-class express. The driving wheels are six feet in diameter and are capable of making 500 revolutions in one minute. The weight of the entire car with its motors is but ten tons. These electric carriages or cars will be illuminated and heated by electricity and will contain all the modern appointments for the comfort of passengers. There will be no conductors and no brakemen. It will be possible to stop the car within half a mile by means of the motors themselves and auxiliary electric brakes. "Through" cars will run at intervals of an hour or oftener, according to the requirements of the traffic. Accommodation cars will run every half hour, stopping at all points along the line.

The First General Treatise on the Electric Railway.*

BY CARL HERNIG.

It is a pleasure to greet the first complete work on that branch of electricity which, owing to its phenomenal strides during the past few years, is at present the most important in the later developments of electrical engineering. That such a book was needed will be acknowledged by any one who is interested or is working in this field, and we are pleased to be able to say from a hasty perusal that there is little doubt that it will be read with great interest and profit by the large number of engineers who have entered this field, as well as by those financially interested in electric railways.

There are probably few, if any, who have had the long and very valuable experience in the electric railway field that Mr. Crosby has had, and there are not many who are better posted in the literature on this subject than Dr. Bell. The combination of two such writers, therefore, is of itself a good guarantee of the value of the work. The book is specially characterized by being eminently practical, and it is evident throughout the greater part of it that much of the information is the result of a great deal of valuable practical experience. There is an almost complete absence of mathematics and abstruse theories, the few simple formulæ that are given being of such a nature that they are very easily understood and used by almost any one.

The book contains quite an amount of very valuable information, instruction and hints for the technical engineer and the operator, while at the same time the language is such that it may be easily read and understood by any one, even though he have but a slight knowledge of electrical matters. While its chief value is as a book of instruction and reference to electric railway engineers and operators, it can be read with great profit by capitalists and railway men who contemplate introducing electric railways.

Almost the entire matter is new, the use of the "shears and paste," which are such formidable tools in the hands of many book makers, appearing only in a very few well selected cases where other authors are quoted, and there to advantage. The tone of the book is not as if written by mere enthusiasts, who believe that the electric railway is the only proper one to introduce in any case, but on the contrary the authors do not hesitate to express their opinions freely on the shortcomings of the systems. Throughout the book there appears to be a frank and unbiased expression of opinion. That the book is quite up to date will be seen from a number of the foot-notes giving information which has appeared quite recently.

Regarding the arrangements of the subject, there are a few points which may be criticised unfavorably. It will be found, for instance, that the same subject is sometimes discussed in a number of different parts of the book, though not in the nature of a repetition. This diminishes the value of the book as one of reference. We fully appreciate the difficulties encountered in the classification of subjects, but it would have been desirable in unavoidable cases if cross references had been added. This may be excusable, however, considering that the book, in order to be up to date, had to be completed with as little delay as possible.

Special attention appears to have been given to the illustrations, almost all of which are new, and appear to have been made specially for this book. They are very clear and to the point.

The authors have, as a rule, confined themselves to discussions of general principles, methods and results, rather than to the detailed studies of the specific parts, believing that "the latter course would soon lead us into the mere allotment of a graveyard for defunct apparatus," as they tersely expressed it. The discussion of specific parts, however, has not been omitted by any means, enough attention having been devoted to it to give one a very good idea of what has been done and in what direction improvements are desired and are to be expected.

The book is divided into 12 chapters and 5 appendices on various subjects. The first chapter, on general electrical theory, gives a very short and clear insight into the subject of electric currents, dynamos, laws, etc., as far as they should be understood by any one having to do with electrical apparatus, such as is used on electric railways. The subject of dynamos is discussed to the extent of showing how a dynamo should be calculated, by giving an example of an actual case. One very commendable feature of the book shown here and in many other places is, that instead of giving abstract laws, concrete examples are worked out with actual figures, a feature which will be greatly appreciated by practical men who have an aversion to abstract laws and rules, as often given in text books by authors who, we dare say, sometimes cannot apply them themselves in actual practice.

Chapter II. is devoted to prime movers, that is, to steam engines and water wheels, which are regarded by them to be at present the only prime movers worth considering. The theory and principles of the steam engine are ex-

* THE ELECTRIC RAILWAY IN THEORY AND PRACTICE. By Oscar T. Crosby and Louis Bell, Ph. D. 400 pp., 179 illustrations The W. J. Johnston Co., Ltd., New York City, Publishers. Price, $2.50.

plained at some length, perhaps more than is really necessary here. Quite a good insight into indicator diagrams is given, accompanied by a number of illustrations, showing actual diagrams of properly and improperly running engines. A number of pages are devoted to the water wheel, giving a general insight into the subject, including also a mention of the shortcomings of turbines.

Motors and car equipments are discussed at considerable length in Chapter III., much attention being given to the discussion of the regulation of motors. The effect of varying the field strength and the electromotive force to produce regulation is illustrated by a number of examples worked out in actual figures and without the use of any abstruse mathematics or complicated formulæ. This is followed by a description of the customary methods of producing changes in the field and electromotive force in order to affect regulation, special attention being given to the method of winding the field in sections, which are variously connected with each other. The different methods of connecting the two motors with each other, as well as the question of whether series or shunt wound motors are best, are considered at some length. Good reasons are given for the present practice of using series motors, although they state that "it is certainly true that good service would be had from a shunt-wound motor, speed control being effected mechanically or through rheostats placed in the armature and the field circuits. Under the subject of gearing, the various methods are discussed, special attention being given to spur gears, which are treated at some length. The illustrations of motors are limited to a half dozen of the latest typical forms of the best makers.

The gearless motor is discussed at some length; although its advantages are pointed out, their opinions as to the future of the gearless motor were not altogether sanguine. The same may be said of their discussion of the subject of separate locomotives.

In reference to the electrical heating of cars, they give its advantage, but state that it will cost 72 cents a car per day, as compared with 10 cents for stoves.

Under the subject of car trucks, the general principles of trucks and the distribution of the load so as to give the best starting effort are described, with special reference to the mounting of grades; this is accompanied by illustrations of a number of the typical forms, and by examples worked out for practical cases, for various grades and dispositions of the load on the wheels. This is followed by a description and discussion of trolleys, car connections and lightning arresters. The chapter is concluded by a set of very practical "general instructions for the care of motors," which show that the writer has evidently had a great deal of experience with teaching attendants what to do and what not to do.

Chapter IV. is devoted entirely to the subject of the line, to which much space is given. Diagrams are given showing the six different methods by which the trolley lines and feeders are run and giving the advantages of each method, besides working out examples for actual cases. Underground feeders are passed over with little more than mere mention, and a statement that "thus far all efforts—and they have been many and ingenious—to successfully insulate the conductors in a conduit have failed, save when topographical conditions were favorable." This statement, however, seems hardly justified, in view of the fact that the Buffalo plant has been working very successfully with underground feeders, and also as underground circuits are used so very largely in European cities. If the Europeans can insulate underground wires, why cannot we do so? It is to be regretted that this subject was passed over with such a short mention.

The subjects of tracks, car houses and snow plows form a short but well illustrated chapter, giving a number of valuable hints concerning time saving machinery in car houses. The subject of tracks is quite fully illustrated and is accompanied by some practical advice from Mr. F. H. Monks, of the West End Company; $10,500 per mile is given as the approximate cost of construction of a single track, not including the paving. The station is next considered in quite a long chapter. Regarding the location, they state that the first thing to be considered is the nearness to the supply of fuel, and after that, central position with reference to the line, and finally, availability of water. The kind of engines, size of units, and the capacity with reference to the number of cars is then discussed and is followed by three specimen cases of station which are treated in considerable detail, one for a 5 car road, one for 25 cars, and one for 100. Examples are given, showing how to calculate the power under various conditions of load, grade and service. This is accompanied by plans showing the arrangement of power stations, giving information regarding the most suitable disposition of the machinery. Regarding the power units, they state that "the number of power units should be just such that the disabling of one of them will not interfere with the successful operation of the system." The chapter is concluded with a number of useful and practical hints for the care of the power station, which show that the author has had considerable practical experience himself.

The efficiency of electrical traction is next considered. Beginning first with the engine, they give results in a number of cases, showing what efficiency may be counted on in such service, accompanied by data taken from a number of actual cases. They state, that "with a thoroughly well designed power station, the efficiency of the engine so far as frictional losses are concerned may be raised to between 85 to 95 per cent., with direct belting to dynamos or good countershafting, while under less favorable circumstances it is likely to fall to 70 per cent." Dynamo efficiency is next considered, and the conclusion is arrived at that the best practice is to belt or couple the dynamos directly to the engine wherever possible. The line efficiency is given at 90 to 95 per cent.; that of the motor, which is treated at some length, is said to be inextricably involved with the efficiency of the gearing, but it is stated that the possible average efficiency of a properly designed motor may be as high as 80 per cent. and even higher, though at present the efficiencies even fall between 60 and 70 per cent. For the total efficiency, between the indicated horse-power at the station and the power actually delivered at the car axle, tests are said to have given from 25 to 37 per cent. They estimate that in a few cases it would fall below 30 per cent. and in still fewer it would rise much above 40 per cent.; anything over 50 per cent. being attainable only with the utmost care in designing and construction and it is doubtful whether this point has ever been reached. In conclusion they say, "No stronger argument can be obtained in support of electricity as a motive power than the fact that, taking the electric railway as it is to-day, even though nearly two-thirds of the power generated at the station is lost on the way, though the expenses for repairs are sometimes heavy and the first cost of equipment great, it stands quite unapproached as a method of effective rapid transit." The cost of fuel, they say, is nearly in every case less than 10 per cent. of the total expenses of the road; and increase in the efficiency therefore would diminish but little the total cost of operating.

The next chapter is devoted to storage battery traction, and begins with a general description of the storage battery itself, pointing out its shortcomings. The general tone of this chapter is very discouraging for storage battery traction, although they do not fail to point out its advantages and close by saying, "It is only fair to say that if the accumulator can be made durable and of considerably higher weight efficiency than is now used, it will have a wide field of operation wherever overhead wires are objectionable."

They next consider miscellaneous systems, including the conduit system successfully used in Budapest. We call attention here to an error on page 257, where the grades on this road are given as 15 and 16 per cent, which should read 1.5 and 1.6 per cent. Series systems, closed conduit systems, telpherage lines, etc., and the use of alternating currents, are described in turn.

In the chapter on high speed service, which is one of the most important directions of development of electrical railways, very much interesting and useful information and data are given, accompanied by calculations of what has been done and what can be expected; also a summary of the now well-known experiments of Mr. Crosby on high-speed work, concluding with some calculations and deductions as to the commercial aspects of high-speed railroading.

Under the subject of commercial considerations the costs of construction and operation are discussed in detail and with considerable thoroughness, including data obtained from a number of roads.

The final chapter gives a good summary of the history of electric railways.

The appendices include the following subjects: The decision in the case of electric railways versus telephony, instruction to linemen, including a large number of cuts and good advice; a form for the engineer's log book, an article by Mr. Bettis on the classification of expenditures of electric street railways and one by Prof. Elihu Thomson on lightning protection.

Annual Report of the Edison General Electric Company.

The third annual report of the Edison General Electric Company, which was made public last week, will be of considerable interest in view of the proposed consolidation of the company with the Thomson-Houston company, the details of which were given in last week's issue of THE ELECTRICAL WORLD. The report of the year's business shows that the gross business of the company was $10,942,640, on which the profits—including the $271,592 written off against the cost of the manufacturing plants—were $1,666,535. To this amount must be added the general receipts at the main office ($83,013) making total net earnings of $1,749.549. Deducting from the net receipts of the company, exclusive of those of the Edison Electric Light Company, the sum of $271,592, charged off on the manufacturing plants, and $286,177 charged off against liquidation, materials in stock and experiment account, we have $1,191,479 as the net result of the year from the business of the Edison General Electric Company alone. Adding $1,100,432 surplus profits carried over from the preceding year, there is a total of $2,291,911 profits available for distribution. After paying $1,031,845 in dividends, $1,260,066 is carried forward into the new year. The Edison Electric Light Company received during the year $631,672 in bonds and stocks as license fees from licensee companies, worth, at a moderate valuation, about $500,000, of which the general company is entitled to over 90 per cent., or nearly $495,000, which is equal to 3.16¾ per cent. additional on the capital stock. The general balance sheet shows a footing of $21,507,284 for 1891, against $17,958,852 in 1890, an increase of $3,548,431. The gross sales of the company reached nearly $11,000,000. The bills and accounts receivable increased only $261,663 during the year, showing the promptness with which the collections were made. The year's profits were diminished somewhat by the considerable decline in prices for the product, owing to increased competition, etc., and also from the general business depression and the unwillingness of capital to embark in either old or new enterprises. These general conditions imposed great caution upon the management. A much larger business could have be done had the company been willing to accept securities from purchasers in payment for orders, but it was determined to do all business exclusively on a cash or short credit basis. Securities were accepted, however, in settlement of some contracts taken by the prior organization and management, thus accounting for nearly the whole of the increase of $502,842 in "sundry stocks and bonds."

The following comparison between 1890 and 1891 may be of interest:

	1891.	1890.	Inc.	Dec.
Gross business	$10,942,640	.....	.....	.....
Gross profits	2,544,288	$2,368,927	$175,361	.....
Depreciation	271,592	266,071	5,521	.....
Balance	2,272,696	2,102,856	169,850	.....
Expenses	794,738	206,678	588,059	.....
Net profit	1,477,958	1,896,177	.....	$418,219
Written off patents	.....	100,000	.....	100,000
Balance	1,477,958	1,796,177	.....	318,219
Wr. off for stk. of Cos. cons., etc	286,477	614,711	.....	328,234
Balance	1,191,480	1,181,466	10,014	.....
Dividends	1,031,845	665,314	366,531	.....
Surplus	159,635	516,152	.....	356,517

At the annual meeting of the stockholders of the company, which was held Feb. 10, the following trustees were elected for the ensuing year: C. H. Coster, Thomas A. Edison, J. H. Herrick, Samuel Insull, Edward H. Johnson, A. Marcus, Carl Schurz, Francis S. Smithers, Samuel Spencer, Henry Villard, J. Hood Wright. The only change from the former board is the election of Samuel Spencer (of Drexel, Morgan & Co.) in place of James B. Williams.

The board met on Feb. 12 and organized for the election of officers for the ensuing year. The old officers were re-elected without opposition as follows: President, Henry Villard; vice-president, J. H. Herrick; second vice-president, Samuel Insull; secretary, A. Marcus; treasurer and assistant secretary, F. S. Hastings; assistant treasurer, A. S. Beves; comptroller, Joseph P. Ord. As soon as the election was announced, the following letter was read:

FEB. 12, 1892.

To the Board of Trustees of the Edison General Electric Company:

When I went to Europe in June, 1890, intending to be absent a whole year, my resignation from the presidency of the company was left in your hands. It was not accepted, and, against my wish, I continued to hold the position. The rapid growth of the company's business has made it clear to me, however, for a long time past, that some one should fill the difficult place who could devote all his time to its duties, which my other occupations have not permitted me to do. You have just chosen me for a third time as the chief executive of the company. While I am sincerely grateful for your confidence, I can only accept with the distinct understanding that I shall be at liberty to retire whenever a suitable successor acceptable to you can be found, but in any event not later than April 1 next.

Yours truly, HENRY VILLARD.

J. Hood Wright, of the firm of Drexel, Morgan & Co., offered a resolution, which was carried, to the effect that the board expressed its regret at the withdrawal of Mr. Villard and their thanks for his services to the company. The meeting then adjourned without transacting any further business.

Brilliant Display of the Aurora Borealis.

It is not often that so brilliant an exhibition of the aurora borealis as that of last Saturday evening is permitted to observers in this latitude. Between the hours of 7 and 8 in the evening the heavens presented a magnificent display which was witnessed by observers in all of the northern States from the Atlantic to the Missouri River. Shortly after 7 o'clock it suddenly burst from the northern sky like long, lofty banners of fire. From the constellation of the Great Bear in the north to Cassiopeia, about one-third of the distance to the south and extending about sixty degrees from the horizon, the heavens were illumined by a soft, reddish light. It grew more and more brilliant and gradually extended toward the zenith. Then the ruddy hue began to soften into a rosy pink, and as it did great broad bands of white light spread vertically from the horizon to the zenith. Not for a single minute did the color remain unchanged. In the middle of the illumined part of the heavens it grew blood red, while on the edges the pink tint was very delicate. The rest of the sky in comparison seemed darker, and on this background the phenomenon formed a spectacle of marvelous beauty.

The aurora borealis caused considerable trouble among the telegraph operators who were at work at points extending from New York to as far west as Chicago. At this time of the year such atmospheric disturbances telegraph men say are rare, but the electricity in the air Saturday afternoon and evening caused nearly as much trouble as the aurora borealis of 1882.

"The aurora borealis acts much the same on telegraph wires as lightning does, only the former does not burn out the wires," said J. C. Robinson, general traffic chief of the New York office of the Western Union company, to a reporter. "During these atmospheric disturbances no batteries would be necessary in telegraph stations if the elec-

tricity should remain steadily in the air. But it comes and goes in waves, and, of course, when the wave is not present the battery must be used. But when the wave is passing over the battery cannot be used, and it was at those times that the operators were interrupted at their work. The office at Buffalo seemed to be the one most affected Saturday afternoon and evening, but it was also felt in Cincinnati, Detroit and Chicago. Several times during the evening no batteries were used when sending messages between the New York office and Albany, the aurora borealis furnishing all the electricity necessary."

Concerning the theory of the aurora, Prof. E. J. Houston, in the second edition of his "Dictionary of Electrical Words, Terms and Phrases," says that "the exact cause of the aurora is not as yet known. It would appear, however, beyond any reasonable doubt, that the auroral flashes are due to the passage of electrical currents or discharges through the upper and therefore rarer regions of the atmosphere. The intermittent flashes of light are probably due to the discharges being influenced by the earth's magnetism. . . . Whatever may be the exact cause of auroras, their appearance is almost exactly reproduced by the passage of electric discharges through vacuous spaces."

Garrett P. Serviss, in his lecture at the Cooper Union on "How Worlds Are Made," said that the magnetic connection between the sun and the earth was the cause of the lights in the northern sky, which most of the audience had seen before they came to the lecture. The recent appearance of the spots upon the sun showed that a tremendous disturbance was taking place upon the surface of that body. The earth had responded to the electrical impulses from the sun and its magnetic condition had actuated electrical currents in the atmosphere. He said that the principle of the aurora borealis was the same as that shown by the Geissler tube, in which electricity is discharged through rarefied air.

Elements of Practical Electricity.*

BY DR. LOUIS BELL.

With the resistance coils you have made you can very easily make up a Wheatstone bridge in the exact form of the diagram of Fig. 36, which will enable you to study its properties quite readily. For this purpose a block of wood about six inches square with four binding posts screwed into it near the four corners will serve admirably. You can then make the four arms of your bridge with three known and one unknown resistance coil, connect your galvanometer across one diagonal and your battery across the other diagonal and proceed to make any measurements you please. As you are not possessed of a regular resistance box as yet you will do well to build up this simple bridge by employing your two two-ohm coils for two sides of it, putting the unknown resistance for a third, and completing the bridge with a piece of German silver wire from which you have stripped the insulation. By clamping different lengths of it between your binding posts you will find yourself possessed of a very handy variable resistance and can set up an unknown coil against it very nicely; the only precaution to be taken is to measure the length of wire in each case. As you have already found its resistance per metre you can find the unknown resistance at once. This same device of using a length of German silver wire will also prove convenient in using a bridge under any circumstances in which no resistance coils are at your command sufficient to enable you to work readily. For example, if you have to measure a resistance of 1.4 or .5 ohms and have no half-ohm coil, you can easily use a bit of German silver wire in conjunction with a one-ohm coil whenever you do not care to use your slide metre bridge.

As to resistance boxes their construction is very simple. The coils are arranged in order of size in regular lines in a shallow box of sufficient size to accommodate them, and the terminals are soldered to heavy brass contact pieces upon the top of the box. As resistance boxes are made up for regular use they are frequently so arranged as to serve both as a resistance box and Wheatstone bridge combined. Connections to the various coils are not usually made by means of connecting the leading wires directly to the terminals of a particular coil, but the wires are attached to a pair of general binding posts, and the requisite coils are then put in series by means of contact plugs. In the form most commonly used a heavy brass strip, a quarter of an inch or more thick and half an inch wide, is fastened along the top of the resistance box. This strip is not continuous, but is divided into sections, perhaps an inch and a half long, by narrow cuts. Each of these cuts is directly through the centre of a slightly conical hole, such as could be readily drilled in the bar before cutting. Into each of these holes is fitted a tapering brass plug with a suitable handle. To the terminals of the brass bar made continuous by the plugs are attached the leading wires, for any purpose for which the box is required. The coils within the box have their terminals brought through its top, and soldered to the brass bar, so that each coil forms a connection across one of the gaps between the sections of the bar. The action of this arrangement is as follows: so long as the connecting plugs are all in place the resistance coils are short circuited; on removing the plug, the resistance coil corresponding to that particular gap is thrown into circuit. The coils are thus very compactly and conveniently arranged for use.

If you are handy in working metal you can readily make a box on this plan, but the special difficulty is in securing a nice fit of all the plugs.

The order in which the coils should be arranged is as follows: One ohm, one ohm, two ohms, two ohms, five ohms, 10 ohms, 10 ohms, 20 ohms, 50 ohms. This includes all the coils you have made. If you were going on further it would be a repetition of the same order of the last four coils, each multiplied by 10. You really need only one of your one ohm coils to make all the necessary combinations, but the second, although it may not be ever used, is occasionally a convenience. This arrangement of coils is the one which requires for any given range of measurement the smallest number of individual coils. Resistance boxes of this pattern are therefore cheap and compact compared with any other arrangement of coils of similar quality.

As I have just mentioned, they are not infrequently made so as readily to be employed as a Wheatstone bridge. For this purpose the regular resistance box is used as the variable arm of the bridge, and extra resistances are furnished for the two fixed arms. Fig. 38 gives a very good idea of this arrangement. Comparing this with Fig. 36 you will see that the main body of the resistance box corresponds to one of the arms *B* or *D* of Fig. 36. The unknown resistance represented by the outside wire in Fig. 38 is one of the pair *B* or *D*, Fig. 36, while *A* and *C*, Fig. 36, are formed by two sets of coils of 10, 100 and 1,000 ohms each. The purpose of these is to increase the range of measurement possible by using for the ratio of the arms of the bridge not unity, as would be the case if the coils were equal, but one-tenth or a one-hundredth, so as to increase the range of resistance that can be measured by the coils at hand. It is precisely the same sort of thing that you do by shifting the contact in the slide-metre bridge, except that instead of shifting it to various points to complete the balance, in this case you merely alter the ratio by a definite amount and then complete the balance with the resistance box. With the arrangements of resistance box and bridge shown in Fig. 38 with the fixed arms equal you would be able to measure any resistance between one ohm and 10,000 by the addition of these extra resistances. Changing the ratio it becomes possible to measure resistances from about one one-hundredth of an ohm to over a million ohms.

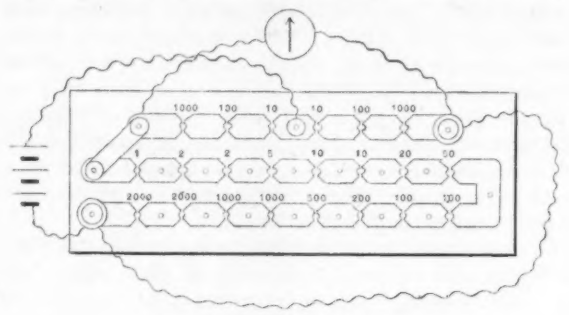


Fig 38.—Resistance Box.

It is unnecessary to state that these proportional coils must be very accurately made in order to get good results from their use. Fig. 38 gives so good an idea of the arrangement of an ordinary bridge box that you will be able to study out for yourself the various combinations which can be made with it, remembering always the fundamental principles of the bridge, as previously laid down.

Fig. 39.—Testing Set.

Resistance boxes of this general sort are sometimes known as plug-out boxes, from the fact that the insertion of the plug cuts out the resistance.

There is another variety of resistance box which has come into considerable employment, which is sometimes called a plug-in box, from the fact that with the insertion of the plugs the resistances are put in along with the corresponding plugs; they have the advantage of a very much smaller number of contacts and hence perhaps less errors in measuring small resistances, but compensate for having fewer contacts by having more coils. This arrangement, as usually made, includes, like the one just mentioned, proportional coils and connections for using the whole as a bridge. Fig. 39 gives a good idea of the plug-in resistance set as often arranged.

As will be seen by a glance at the figure it consists of a set of four general contact bars, one for thousands of ohms, one for hundreds one for tens, and one for units.

Close by the edge of each of these bars is a series of terminals connected to the coils in the box, and between each terminal and the main bar is the same arrangement of narrow slot and hole for plug that has been already described. The connections within the box may obviously be made in various ways, the simplest of them, perhaps, being the following: The 10 unit coils are each of one ohm and connected across gaps between the terminal plates just as has been described in connection with the ordinary form of resistance box. Instead of plugs being inserted between these terminals, however, they are inserted between any of the terminals and the main bar. Now let the leading wire be connected to the zero terminal of the units row, then placing a plug in the gap between any terminal and the main bar thrusts in a resistance equivalent to the sum of the coils up to that point. The arrangement of the 10,000 and 1,000 are precisely the same, current flowing through the rows successively. The upshot of this method of connection is that the insertion of four plugs will give at once any resistance up to the extreme limit of the capacity of the box. The number of coils required is, however, much greater than with the plug-out system of arrangement. With the plug-in resistance box there is almost no danger of making a mistake in reading off the resistance, so that for inexperienced persons in places where rapid work is very necessary it is often to be preferred. The proportional coils in this case are used just as has been described. As made up for practical use a resistance set of this sort generally includes galvanometer and battery keys, a very compact portable galvanometer and sometimes a testing battery. Such testing sets are of the greatest convenience, as they are quite compact and can be readily used in situations where measurements would otherwise become very difficult.

You will find it convenient to make up your resistance coils into a box, and you may also very readily construct a set of proportional coils, using the slide metre bridge and resistance box to graduate them as carefully as possible. With this equipment you will be able to execute any ordinary measurements of resistances with the utmost readiness.

*Continued from The Electrical World of Feb 13, 1892.

Mr. O. T. Crosby's Opinions on Surface Electric Traction.

Mr. O. T. Crosby, the general manager of the railway department of the Thomson-Houston company, has had such a wide experience in the operation of electric street railways that his opinions deserve careful consideration. In talking with a reporter recently about the adoption of the trolley system of electric traction for some of the surface roads in Brooklyn he said:

"On the whole, I am heartily gratified at the outcome, for after protracted discussion the decision is emphatically in favor of the trolley. Its introduction was bitterly opposed, as has been the case in other cities, not by the great mass of the people, to whom a half hour saved by rapid transit means more home life, more happiness and health, but by those who do not habitually use street cars. The attack on the electric railway is undemocratic to the core. The trolley system is not the only method of electric traction, but it is the only one which operates successfully and in which level-headed business men have found cause for enough confidence to back it with their dollars. The storage battery has friends among electrical enthusiasts, but three years of trial right here in New York have ended in the withdrawal of every car, and that in spite of the fact that they were continually under expert care and supervision. The storage battery of to-day is unable to endure the severe conditions imposed by every-day street railway service, and nearly two tons of batteries must be continually dragged around on each car.

"A great many thousand dollars were spent in Boston in trying to operate a conduit road, and the result was total failure. It was costly to install and well nigh impossible to operate. The main difficulty is that in our northern climate it seems to be impracticable to keep a slotted conduit free from water, mud and slush. These reach the bare conductors that furnish the current, 'short circuit' them, and your line is crippled. Only in better climatic conditions or by the help of considerable improvements can success be secured.

"When the electricians put the electric pressure on street railway circuits at 500 volts they knew just what they were about and had the safety of the public in view. The history of the service has proved the wisdom of their action. The trolley has never caused the death or serious injury of a single human being, in spite of all the hue and cry against it. Every statement to the contrary has upon careful investigation been found to be untrue. I have investigated numerous reports of accidents, and they have, without exception, proved to be either gross exaggerations or baseless rumors. Hundreds of electric railroad employés have received shocks from the full pressure of the trolley wire in working about the power stations and car houses without result more dangerous than a scare and trifling burns. The pressure on the trolley wire is automatically kept constant. I have personally received shocks from the full pressure of a trolley wire, and know from experience that the effects are not serious. The only legitimate objections to the trolley system are æsthetic ones, and with our new noiseless motors and the improved and less obtrusive methods of overhead construction even these are of little moment."

Two Proposed Methods of Transmitting Power from Niagara Falls to Chicago.

BY F. C. PERKINS.

Electrical engineers in America followed the progress of the Frankfort-Lauffen power transmission with so much interest that a few details of two systems radically different from each other, proposed by two European electrical firms for the Niagara Falls transmission, will not be uninteresting.

The following information was furnished by Mr. Emil Huber of the "Machinen fabrik Oerlikon," at Zurich, in regard to the machinery which it would be necessary to use in the Niagara Falls-Chicago power transmission, if the "drehstrom" system should be used. It is intended to use the generators and motors after the close of the Exposition in the Niagara-Buffalo transmission, according to the plans presented by Mr. Huber's company to the Niagara Cataract Construction Company, of New York.

As these plans cannot be published at present the following data is all that can be given. The transmission plant proposed by Mr. Huber is either of 5,000 h. p. or 2,500 h. p., as may be desirable, in either case the potential on the line being 25,000 volts.

Mr. Huber and Mr. Otto Frick, one of the engineers of Oscar Von Müller, in München, both agree that the transmission with direct current could be made according to the plans of R. Thury very efficiently, but that the great objection to those plans would be not in the possibility of maintaining the operation of the line perfectly, but in that of the use of so many generators, which would need to be built with the greatest care to use 3,000 volts. They claim in a transmission with direct current no trouble need be expected with the line but with the generators, while with the "drehstrom" system the generators would give no trouble whatever, but there might be great difficulties with the line on account of the self-induction and capacity being so great for 700 kilometres. However, from experience at Frankfort, Mr. Frick thinks it could be done, since the loss by condenser capacity was found to be less than one per cent., the loss being much less than with concentric cables, since the conductors are much further apart.

The generator used, whether of 2,500 or 5,000 h. p., would be mounted for armature revolving vertically and connected directly with the turbine. The 5,000-h. p. generator would have a normal speed of 300 revolutions, with an output of 2,000 ampères at 650 volts; and in case one machine of 5,000 h. p. is used three step-up transformers connected in series would be necessary, each of 1,700 h. p. and with a ratio of 650 to 25,000, the number of periods being 20.

If, however, two machines of 2,500 h. p. each are desired, one transformer of 2,500 h. p. would be necessary for each machine. If 2,500-h. p. generators are used the number of cycles would be 40, the E. M. F. 350 volts, the speed 400 revolutions, and the ratio of the step-up transformers 350 to 25,000.

If thought desirable sub-stations could be placed outside of the city lines of Chicago, the step-down transformer first reducing the voltage to 2,000 and then to 150 volts. This would allow the use of arc and incandescent lamps with great ease, arc lamps being run in series and incandescents in parallel.

Mr. Huber claims for the transmission at Frankfort 72 per cent. efficiency to the lamps and 67 per cent. to the

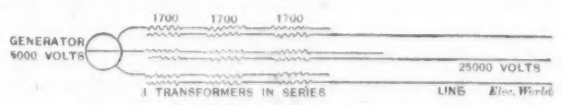


FIG. 1.—HIGH POTENTIAL TRANSMISSION OF POWER.

shaft of the turbine from motor, allowing 90 per cent. efficiency for the motor, 95 per cent. for the generators, and 96 per cent. for the transformers.

It is of interest here to note that a transmission is now being made from Bulach, a village 12½ miles from Zürich, to the works of the Oerlikon company. A generator of 300 h. p. is used at Bulach, similar to the one used at Lauffen, and the pressure on the line is about 15,000 volts, while that of the generator is 50 volts. The motor at present being tried is of the same design as the dynamo.

It is also of interest to note that Mr. Huber has also designed a machine of the "drehstrom" type, with a normal pressure of 25,000 volts. Whether it will ever be built or not the designer did not state; but it is certainly true that machines of very much higher potential can be built on this system than with the direct current system, inasmuch as the moving parts are of iron, and the windings may be made stationary, oil or paraffine insulation being used as with the transformers.

In explaining the system proposed for this installation Mr. Huber said: "I would never trust to any continuous current machinery of any of the known types of armature windings and commutating devices to stand a potential above 3,000 or 4,000 volts, this being the highest attained in our experience. On the other hand, it is settled by experience that in coils that do not move the pressure may be raised to 30,000 and even 40,000 volts, because such coils allow of being insulated heavily, and, if desired, with oil.

"I understand that the Niagara transmission is to be carried out from the beginning on a commercial scale and that the plans must be such as can be carried out at once with the means now at hand and with a sufficient guarantee of an economical and regular working. For this reason extensive experiments with new systems, however promising, cannot be thought of, and we claim that our projects are kept within safe limits and cannot be looked upon as ventures.

"The Frankfort-Lauffen tests and the tests that are constantly carried on at our works show that a pressure of 30,000 volts is not beyond safety. Therefore, for the short distance between the Falls and Buffalo of 32,000 metres no excessive voltage is needed. With a pressure of 25,000 volts the cost of the line is no more than 25 per cent. of the total cost of the electrical part, with a loss on the line of five to six per cent. We think it wise to run separate lines of 5,000 or perhaps 10,000 h. p., the wires being light enough to allow of being carried on wooden poles. In running a number of lines the chance of partial breakdowns may be somewhat greater than in running one line of the whole capacity, but there is hardly any chance for a total breakdown of power supply, as the load of any generator or transformer may be thrown upon any of the lines. There is also one advantage, consisting in the possibility of building a moderate number of units without

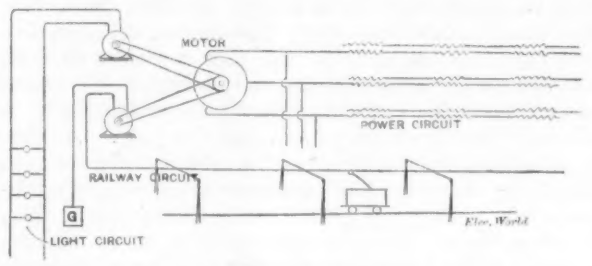


FIG. 2.—HIGH POTENTIAL TRANSMISSION OF POWER.

investing an immense amount of money in iron line structure that will one day carry a larger number of lines or units.

"In recommending the alternate current system it is not needed to point out the advantages especially of the multipolar system, that will permit of starting and running motors of any size. But there are different ways of carrying out an alternate current transmission, though the line pressure may be the same in all cases. One method would be the use of 5,000-h. p. generators with revolving field magnets, making 200 revolutions per minute, 650 volts pressure, coupled to three transformers in series of 1,700 h. p. each, with a frequency of 20 total cycles per minute. The line pressure would be 25,000 volts between the wires, and the total efficiency 85 per cent. This low frequency would not be suitable for direct lighting. It would be necessary to run large motors at the secondary end to drive different kinds of generating machinery for the different purposes.

"A second method would be to use two 2,500-h. p. generators at 400 revolutions per minute, with a frequency of 40 cycles per minute. The E. M. F. in this case would be 350 volts and two 2,500-h. p. transformers would be employed.

"The plan in both cases is to run a high pressure line and a secondary transformer central station with distributing mains. Naturally if there are motors to drive continuous current machinery in this central station itself, 'drehstrom' current of a low potential would be used, but all other energy would be distributed at 2,000 volts and transformed to a lower voltage, where it is needed, as is the customary way with present alternate current light circuits. After all it is advisable to run the currents for large motors entirely separate from light circuits. To illustrate this, I would say that it would be a good plan, in the second case mentioned, to run six wires on the line, though on the same poles, of which three would form the light circuit and three the power circuits.

"As far as the electrical apparatus and line is concerned, the cost of construction and material would be in the neighborhood of $20 per horse power at the distributing terminals of the secondary transformers."

In looking up the principal central stations for the transmission of power in Austria, Switzerland, France, Germany and Italy many different systems were found to be in use with varying success, but the station at Genoa, Italy, was among the most interesting, in connection with a study of the transmission of power from Niagara Falls to Chicago.

The Genoa plant is already in operation and is working very successfully. The E. M. F. used is from 4,000 to 8,000 volts, while the voltage on the proposed line to Chicago, should this system be used, will be 30,000 volts. The system is that of R. Thury, electrician, of Cuénod, Sautter & Co., Genève, Switzerland, and is of the same general principle as the plans for transmission of power by electricity from Niagara to Buffalo furnished by Cuénod, Sautter & Co., to the Niagara commission. These plans took the highest prize awarded; but it is impossible to give the differences and details between this system and the plans given because the Cataract Construction Company believes it to its interest to withhold the plans from the public until after some system is finally adopted. It is stated, however, that the tunnel will be completed and that power may be obtained by the time the World's Fair opens.

The total distance of transmission at Genoa is 26 kilometres. The company operating the station is the "Societá Acquedotto Defewari Galliera," with a capital of 5,000,000 francs. The power obtained is from a small stream in the mountains near Isoverda and Pontedicemo. The total fall is 450 metres and there are three stations built up the mountain side, each having a fall of 150 metres, the same water being used three times.

The highest station is called Paccinotti, the second Volta, and the third Galvani. From each station there are two conductors running to Genoa, Italy, making three distinct motor circuits, each carrying from 4,000 to 8,000 volts according to the load. The motors are all connected in series and vary from 6 to 60 h. p., with a constant current of 44 ampères and a variable voltage of from 50 to 1,150 volts, according to the size of the motor. The current on each line is constant and the pressure varies with the load.

The three stations when complete will be of exactly the same capacity and will be equipped exactly alike. At present there are only two stations in operation, but the third will be ready in a short time.

In each station there are five turbines of 140 h. p. The speed of each turbine is 475 revolutions per minute. To each turbine two Thury dynamos are directly coupled, having a capacity of 70 h. p. each, with a normal potential of 1,050 volts. These turbines were constructed by Faesch & Piccord, of Geneva, Switzerland, the firm whose plans for the Niagara plant took the highest prize in connection with the electrical work of Cuénod, Sautter & Co. There are two pipes conducting the water to the turbines for each station, averaging about 250 metres in length and half a metre in diameter. One of the turbines and two dynamos are held in reserve for use in an emergency.

These generators are all connected in series, making a total pressure on the line of something over 8,000 volts when the eight machines are running. The line consists of two copper wires 9 millimetres in diameter, and each 26 kilometres long; on a careful test made on a rainy day the loss on the 52 kilometres of line was less than one-hundredth of one per cent., the E. M. F. at the time of the test being 4,000 volts.

The governor used is an electric one of Mr. Thury's design. Two direct current machines of 150 ampéres and 100 volts each are connected directly to a turbine of 15 h. p. One of the dynamos is held in reserve, and the other is used for regulating the field of the other dynamos. When a large electric motor is thrown out of use in the city of Genoa, the electric governor slows down the small water motor by electric valve, and the exciter furnishes less current to the field of the large generators, so that the potential of the line is reduced in proportion to the number of motors thrown out of circuit. The regulator works very nicely, as may be seen at the station Volta, now in operation.

The generators have a guaranteed efficiency of 92 per cent., and the motors over 30 h. p. also have an efficiency of 92 per cent, while motors below 30 h. p. are stated to have an efficiency of 88 per cent.

This company, it is stated, has more electrical plants using water power than any other firm on either continent.

Mr. Cuénod states definitely that in case his bid is accepted by the Cataract Construction Company of Niagara, that firm will immediately build large permanent works at

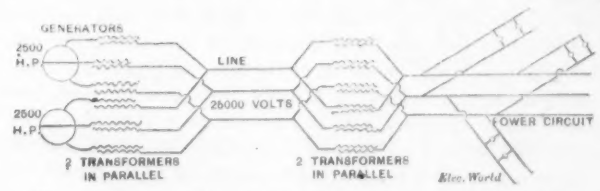


FIG. 3.—HIGH POTENTIAL TRANSMISSION OF POWER.

Buffalo or Niagara Falls; and, according to the plans given below, the generators and motors used for the Chicago-Niagara Falls transmission will be so designed that they may be used at Buffalo later in 1894 with absolutely no change, and at no expense. This makes the transmission to Chicago less difficult, as the expense is reduced about one-half. The wire, too, can, no doubt, be obtained from the various manufacturing firms in America in the same way as at Frankfort. But Mr. Thury also suggests that the insulators and wire can be used in the Buffalo-Niagara transmission, making another great difference in the total cost.

The line is 700 kilometres in length, and the potential to be used is 30,000 volts. The current is to be a continuous one, of 22.1 ampères. This would allow, according to R. Thury's figures, 1,000 h. p. to be transmitted to Chicago at a total loss on the line of 17.5 per cent., *i. e.*, using a wire only eight millimetres in diameter.

Mr. Thury's plan is to have only a single wire, using the earth as the return. However, if two wires are insisted upon, they can be used.

The plan is to use 10 machines, 100 h. p. each, as generators at Niagara Falls, each of 3,000 volts in series, making a total of 30,000 volts, and at Chicago, 8 motors of 100 h. p. each. All of the above mentioned machines being so constructed as to be available at the Niagara-Buffalo Transmission as motors after the fair.

Now, allowing 24.5 per cent. loss by insulation of line, etc., and 90 per cent. efficiency for motors and generators, the total efficiency is 60 per cent., or of the 1,000 h. p. in Niagara, 600 h. p. will be available in Chicago.

To meet the possible objection to high potential motors, Mr. Thury offers a remedy by utilizing the same system as is used at Oyonnax, France. Here the current is conducted to the city limits and then reduced by direct current transformer from 3,800 volts to 120 volts, the pressure on the line being 4,000 volts. In this case the motor, running at 3,800 volts, drives two generators connected directly, each furnishing current at 120 volts. This same plan can be adopted at the city limits of Chicago if desired aud current transformed to 500 volts or 120 volts. These transformers would be also available for use at Buffalo in 1894.

It has been estimated that the weight of copper wire for this transmission of 1,000 h. p. a distance of 700 kilometres would be 312 tons, using wire 8 millimetres in diameter; while the weight of wires used in the Frankfort transmission was 29 tons, for a distance only one-fifth as great.

Utilization of Exhaust Steam from Central Electric Lighting Stations.

The ultimate object of any electric lighting station being to pay dividends, a careful manager who is anxious to increase these dividends ought always to consider all the ways by which this may be done, whether it be from the electricity furnished or by other means. Every one knows what an uneconomical source of power a steam engine is, owing to the fact that so much coal has to be burned in order to get the power into such a condition that it may be used in the steam engine. While it may "look like business" to see black smoke coming from the chimney and white clouds of steam puffing from the exhaust pipe, an observant manager will see in this a great loss of expensive material, while the technical engineer goes further and tells us that under the very best conditions, out of every six or eight pounds of coal an equivalent of less than one pound is turned into electrical energy, from which the

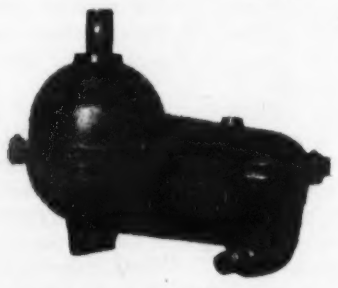


Fig. 1.—Appliances for the Utilization of Exhaust Steam from Central Stations.

profits arise, while the balance of five to seven pounds passes out of the chimney and the exhaust pipe as unproductive of returns.

Wherever water is plentiful and cheap, condensing engines will diminish one source of this waste, but there are many cases in which electric lighting stations are situated in the hearts of cities where water is too expensive to use condensing engines. In such cases another method may be used by which some returns can be derived from the steam after it has left the engines, a method which is used at present in a number of such stations with apparently very good results. In such a system the steam, after it has left the engines, is distributed through the pipes to the neighboring buildings, where it is used and sold for heating purposes. Several methods are in use; in the one the exhaust steam passes directly into the pipes at a small back pressure of five to ten pounds, the water of condensation being discharged; in the second the pipes are run in the form of a loop, returning to the plant where they pass into a condenser. The advantage of the first is that only one system of pipes is required, which, in long lengths, means a saving of many feet of expensive piping. Another advantage is that the pipes need not be so large as in the second system. The advantages of the second system, on the other hand, are, that there is little or no back pressure, and that the plant has the benefit of the hot water which returns through the return pipes. A disadvantage of the second system occurs when the buildings to be heated are lower than the plant, in which case the water must be lost or must be pumped back. The second system is in use at the Thomson-Houston station in the city of Buffalo, and was described in these pages.

Among the most prominent systems of the first kind may be mentioned the Holly system, as introduced by the American District Steam Company, of Lockport, N. Y. At present they have some 40 or 50 steam heating plants in use, including a number of electric lighting stations, using their exhaust steam for heating purposes, among which is one at Ottumwa, Ia., with 2 miles of underground piping, one in Chester, Pa., with 2 miles of piping, and others in Kansas City, Duluth, Springfield, Ill., etc.

The chief features of this system are the means for overcoming certain difficulties which arise in leading steam through underground pipes. One of these is the condensation. To overcome this the iron pipe is first covered with asbestos and has then slipped over it a thick wooden log bored with a hole somewhat larger than the pipe and lined

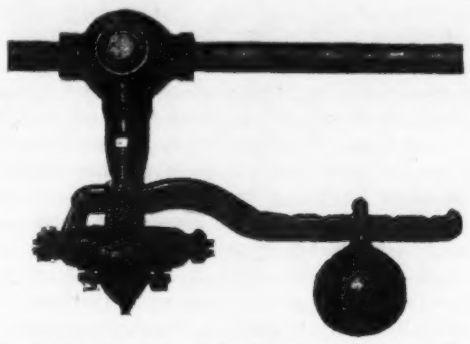


Fig. 2.—Appliances for the Utilization of Exhaust Steam from Central Stations.

with tin, which they claim reflects the heat back. The insulating material, therefore, includes the asbestos, then an air space around the pipe, and then a wooden covering 4 inches thick. The wooden logs are tenoned so as to fit into one another and are coated on the outside with asphalt. A section of this is shown in Fig. 5 on this page. Another important feature is their expansion joint, called a variator. Ordinarily expansion joints are made in the form of a telescope tube with packing boxes and a sliding joint. This, however, requires attention and may give much trouble; such joints also require the construction of manholes to get access to them. In this system this is overcome by a joint which is made of a corrugated diaphragm or ring of copper, as shown in section in Fig. 4, the inside of which ring is connected to one pipe, and the outside to the other, thus allowing for a compensation joint without the use of packing, and requiring no attention. The importance of having expansion joints may be seen from the fact that the expansion of the iron between the extremes of 32 degrees and 307 degrees is about 2¼ inches in 100 feet. One of the variators just described is required for from 50 to 100 feet of piping, depending upon whether it contains one or two diaphragms. Another feature in their system is to provide a continuous anchorage so as to prevent the pipes from creeping.

The piping with its wooden covering is laid directly in the earth, and has placed below it a line of porous tile piping, the object of which is to drain and lead off any water or moisture which may collect in the earth around the pipes. This also is shown in the accompanying Fig. 5. Other features of their system are the traps and the meters, the latter being used in most cases in their central station heating plants. Regarding the meters, it may be of interest here to mention a comparative test made by Prof. Sweet of two of their meters. A 1½-inch meter and a 1-inch meter were connected in series, so that the same steam had to pass through both. The steam was then passed through for a period of eight days, being used to run a steam engine. At the end of this time the readings were taken, and when reduced to the price of the steam it was found that one of them registered a consumption of $16.99 and the other $16.90, a difference of only nine cents in an eight-day run. In another test, occupying four days, the difference was only one cent in a total of $8.82, showing that the meters are relatively quite reliable. In a line of piping constructed as described above, they claim that the loss in the piping itself is only from five to ten per cent. per mile of piping.

The following figures will enable one to calculate approximately the commercial value of the exhaust steam of an electric lighting plant, and the cost of a plant for distributing it. It is stated that 100 h. p. of steam will be required to heat 1,000,000 cubic feet of space, and that a fair commercial rate charged for steam heating in most localities is about $4 per thousand cubic feet of space heated; furthermore it is stated that one square foot of radiating surface is required for heating about 60 cubic feet of air in a room. This latter figure of course is only a general one, as it will depend very greatly upon the exposure of the room, the location of the heater, etc. For exhaust steam the amount of space heated will be a little less than the figure above given.

Assuming, as an illustration, that there is a plant utilizing 1,000 h. p. for electrical purposes, the exhaust steam will suffice for heating about 8,000,000 cubic feet. Assuming $3 per thousand feet instead of $4, this would give a revenue, if it is all sold, of $24,000 a year. Wherever this figure represents a good interest on the capital invested in the underground piping, allowing for the cost of management and repairs, it would be a profitable extension to an electric lighting plant. The cost of piping would of course vary with the size of the pipes, and the distance to which the steam must be led; it will, of course, be less in proportion, the closer the area to be heated is to the electric lighting plant. Some idea of the cost of the pipes may be obtained from the following figure given for an 8-inch pipe, which may be taken as a fair average between the extremes of a 4-inch and a 14-inch pipe used in the system: The cost of an 8-inch pipe, with expansion joints, anchorages, drain pipe, etc., complete in every respect, may be taken as $5.00 per running foot, excluding only the digging and filling of the trench. This does not include the trap nor the meter, which are placed in the house and are charged to the consumer.

In the city of Lockport, N. Y., such a plant was introduced in the year 1877, although improvements have been made since. The total length of piping in this plant is from three to four miles, the longest distance from the plant to a consumer being three-quarters of a mile. The boiler plant consists of a battery of eight 75-h. p. boilers, carrying from 20 to 25 pounds pressure. This pressure is higher than is required for heating, for the reason that they supply steam also for running steam engines for light work. They are at present heating from 5,000,000 to 6,000,000 cubic feet. They state that the coal required for

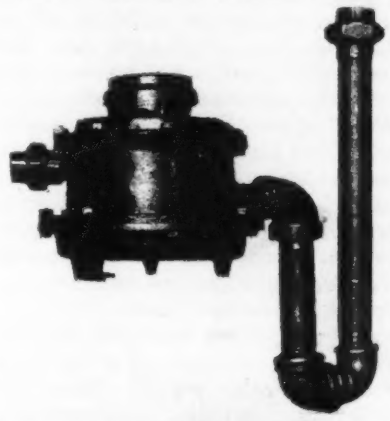


Fig. 3.—Appliances for the Utilization of Exhaust Steam from Central Stations.

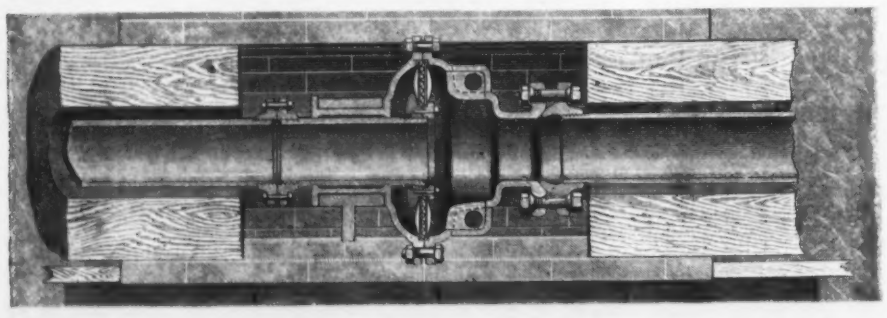
1,000,000 cubic feet, that is for 100-h. p. of steam in their system, is from 800 to 1,000 tons a year.

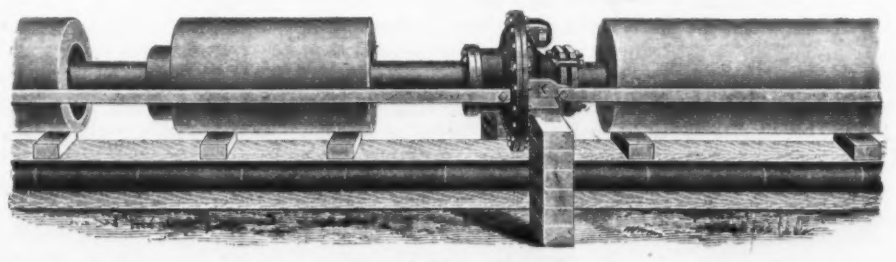
The advantages of steam heating and of supplying steam "by meter and on tap" need hardly be enumerated here, as they have been frequently stated and are well known. Perhaps the best proof is that in all new, large buildings, and in some cases in newly built villages, such for instance as Wayne, Pa., steam heating is employed. In large buildings, in fact, no other method is considered. In the village above mentioned; this Holly system is the one used, and we are informed there are no stoves used for heating purposes in any of the buildings.

Street Railways in Manchester, N. H.

At the first annual banquet of the Board of Trade of the city of Manchester, N. H., held recently, the discussion of the value of electricity as a motive power was prominent in connection with the contemplated building of an electric street railway to the extreme suburbs of the city. The banquet was attended by about 125 representative citizens and business men. The Manchester *Mirror and American*, in its report of the banquet, states that:

"Following the supper, President Slayton rapped the company to order, and, as the hour was then late, stated that the post-prandial period would all be given up to the representatives of the electric companies, and called on Mr. Pierce, of the Edison company, to set the ball rolling. The latter was armed with a formidable roll of type-written manuscript, and proceeded to point out at length the relative merits over all other systems of electric traction of the Edison. He stated that his company was now putting in roads in Augusta, Me., Lowell and Worcester, and that one order it had recently received was for 80 of its new single reduction motors from Milwaukee. He stated that a good road could be built for $5,000 per mile; that it would cost from $3,000 to $5,000 more for each 16 to 20 foot car (the usual allowance being two cars per mile) and stated that he had





FIGS. 4 AND 5.—APPLIANCES FOR THE UTILIZATION OF EXHAUST STEAM FROM CENTRAL STATIONS.

no doubt that a suitable road could be installed in this city, including all expenses for real estate, power, plant and equipment, for from $18,000 to $20,000 per mile. He stated that cost of operation per car mile depended on many things, chiefly on the cost of fuel, the intelligent care of machinery, the physical characteristics of the road, whether the cars are run singly or in trains, and, finally, in the nature of the management, whether it was conservative or extravagant. He stated that no town was better situated for an electric road than this, electricity being frequently called upon to meet and overcome grades of 11 per cent., while here there was nothing heavier, so far as he had seen, than 6½ or 7 per cent.

"Mr. Mansfield, of the Thomson-Houston, followed in a lengthy essay on railway building in general, and aroused considerable applause by prefacing his remarks with the statement that he had no doubt General Williams would build an electric road to the lake the coming spring or summer. During the course of his address he stated that he had no doubt but that Manchester was the only city in New England that was laid out at first by a civil engineer, and congratulated those present on the fact that his ideas had been followed down to the present day.

"Mr. Brown, of the Westinghouse, followed in a short and pithy address on the merits of his system, following which, at 12:25, adjournment took place."

The Determination of the Efficiency of Dynamos.*—I.

BY GISBERT KAPP.

The power given out by a continuous current dynamo, in the shape of current and pressure, can be measured with a very fair degree of accuracy. The ordinary commercial ampère and volt meters now obtainable from good makers may be relied on to be accurate within a few per cent., and in some cases within a fraction of one per cent. In any case there is no difficulty in recalibrating the instruments sufficiently accurately to make sure that the error shall not exceed one-half per cent., so that the maximum possible error in computing the power need not exceed one per cent. Within these limits, then, we are able to tell what the output of any given machine is, and if we could determine with equal certainty the power mechanically supplied to the machine, the determination of the efficiency —that is, the ratio of electrical power given out to mechanical power supplied—could be made with a high degree of accuracy. But, unfortunately, the determination of power mechanically is not an easy matter, and is especially difficult when the power must not be absorbed by but must be transmitted through the measuring instrument. Hence electrical engineers have very early in the development of their industry begun to cast about for some method whereby the efficiency of dynamos might be determined without making a mechanical measurement of power at all.

Probably the first to devise such a method was Major Cardew some six years ago, and his method was prescribed for dynamos supplied under his specifications to the War Office. To make an efficiency test three machines were required, probably differing in output by the amount of power lost in each. The largest machine was arranged to supply current to the medium sized machine, and that again was arranged to supply mechanical power by belting or direct coupling to the smallest machine. In order to work each machine at normal load their sizes must obviously differ. Thus, if *A*, *B* and *C* be the three machines, and if *B* is rated as a 50-kilowatt dynamo, then it will work as a motor fully loaded if 50 kilowatts is supplied to it electrically. Its mechanical output, or the power it supplies to *C*, must be less than 50 kilowatts, because some power is lost in the machine itself. Say the net power available in the spindle of *B* is 42 kilowatts. We supply, then, 42 kilowatts to the spindle of *C*, and obtain from it again less power electrically, say 35 kilowatts. The machines will, therefore, be all working under full normal load if they are designed for an output of 50, 42 and 35 kilowatts respectively. Should *B* and *C* happen to be machines of equal size the test can still be applied, only *B* will be slightly overloaded and *C* will be slightly underloaded. This does not materially influence the accuracy of the test, since the efficiency of a machine is nearly constant for loads anywhere near the normal. The power supplied to *A* need not be measured; all we measure is the electrical power supplied to *B* and the electrical power obtained from *C*. The ratio between the two is the combined efficiency of *B* and *C*, and the square root of this ratio is the efficiency of each machine taken singly.

Another method of testing efficiency was devised some years ago by Dr. Hopkinson and shown to several engineers at the works of Messrs. Mather & Platt, Manchester. The improvement consisted in supplying not the whole of the power required by *B* (as in Cardew's test), but only the power lost in *B* and *C*, the current given by *C* being used to work *B* as a motor. In Hopkinson's method the two machines are mechanically connected, preferably by joining their spindles by a coupling. Over this coupling is placed a pulley, which takes the belt through which the waste power is supplied. In the arrangement adopted at Manchester the driving belt was passed through a Hefener von Alteneck transmission dynamometer, by which the power required to keep the whole system going was measured mechanically. The accuracy of this method is certainly greater than that of the direct method, where the whole of the power is measured mechanically, because an error in the reading of the dynamoter only affects the determination of the waste power, but some slight error may still occur. Say, for instance, that the efficiency of the two machines combined is 80 per cent. Then 20 per cent. of the power of one machine has to be measured on the dynamometer. An error of 10 per cent. in this kind of power measurement may easily occur, and in this case the power supplied would be estimated at either 18 or 22 per cent., accordingly as the error is positive or negative, causing an error of about one per cent. in the final result. Apart from the inconvenience of having to rig up a dynamometer, there is the further objection that we must make the test by means of two totally different sets of measuring instruments which are not directly comparable with each other, and that it is, therefore, not possible to compensate the errors in the calibration of one set of instruments by those in the other set.

In this respect Cardew's test has an advantage. Not only do we use the same kind of instruments when testing

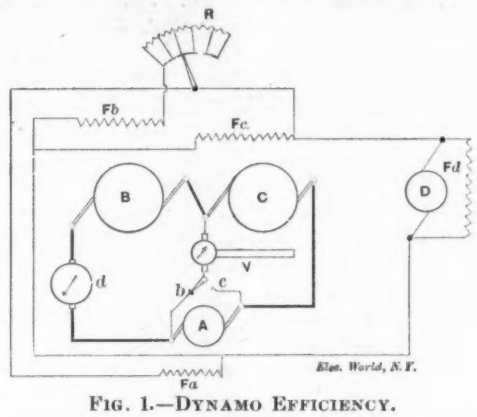


FIG. 1.—DYNAMO EFFICIENCY.

the power supplied and the power obtained, but we can by a suitable arrangement of switches use absolutely the same instruments for both circuits, and then any calibration errors in one set of readings can be partially or wholly compensated by the errors in the other set of readings.

The objection to Cardew's method is that it requires the use of an engine and dynamo more powerful than any of the machines to be tested, and such plant is not always at hand or easily procurable. It is, however, possible to so alter the original arrangement that a comparatively small engine and dynamo will suffice for the testing of large dynamos. Using again the notation previously employed, if, instead of feeding glow lamps or resistance coils from the machine, *C*, we let its current pass through *B*, and thus help working it as motor, then the machine, *A*, need only supply the difference between the power absorbed by *B*, and that delivered by *C*. We have, in fact, the electrical analogue to Hopkinson's mechanical method; and just as in this method a small belt suffices to keep a couple of big machines in motion at full load, so will here a small dynamo, *A*, suffice to keep a couple of large machines, *B* and *C*, working at full load. It is obvious that the connections between the three machines may be arranged in one of two ways. We may either put all the machines in series, in which case *A* must be a machine of low voltage and large current, *i. e.*, the same current as that for which the two big machines, *B* and *C*, are built; or we can place the three machines into parallel connections, in which case the small

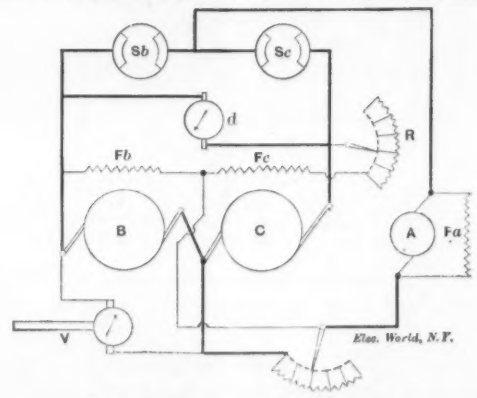


FIG. 2.—DYNAMO EFFICIENCY.

machine, *A*, must be of the same voltage as the two large machines, but need only give a small current. Theoretically, either method is equally good, but, as will be shown later on, there are some practical reasons which generally make in favor of the second or parallel arrangement of machines. Before entering upon a detailed explanation of either method it will be useful to anticipate and answer a question which naturally presents itself in connection with this subject. The question is the following: Why should we go to the trouble of running three machines if we want to know only the efficiency of one; and would it not be equally good to determine the efficiency of this one machine by running it idle as a motor and measuring the power required to drive itself? This would, in fact, correspond to the usual practice with steam engines of taking so-called "light running" or "friction" diagrams. The indicated power required by the engine to drive itself is thus determined, and the brake power may be computed in a rough and ready way by subtracting from the full indicated power that which was indicated when running light. The ratio of brake horse power to indicated horse power is then the efficiency of the engine. Why should we not do something similar with dynamos? Say we have a machine designed to give an output of 100 kilowatts. Leaving aside for a moment the power required for field excitations, which can be easily measured when the machine is in regular work, we wish to determine the efficiency of the armature as an implement for converting mechanical into electrical power. We run the machine light as a motor, and adjust the field strength so as to get the normal speed. The power required to drive the armature can now be exactly computed from the readings of an ampèremeter and a voltmeter. Say we find eight kilowatts is required. Following the analogue of the steam engine, we would conclude that apart from the loss through armature resistance, 100 + 8 = 108 kilowatts must be mechanically supplied to the shaft of this machine if 100 kilowatts are to be taken off at the brushes. If we further find that the field requires three kilowatts for excitation, and that two kilowatts are lost in armature resistance (both of which losses can be accurately measured), we would compute the total efficiency of this machine at $100/(108 + 3 + 2) = 88\frac{1}{3}$ per cent.

Whether this computation is correct or not depends entirely on the question whether we are justified in assuming that the waste of power (other than that caused by armature resistance) is the same at all loads; in other words, whether our eight kilowatts required for light running means a constant addition for any load. Theory and experiment both show that this is not so, but that the power lost increases with the load. The reasons for this increase are not far to seek. Consider what are the causes of this loss. Firstly, we have mechanical friction and air resistance; secondly, magnetic friction, or hysteresis; and, thirdly, eddy currents. The air resistance is unimportant and does not depend on the load; the mechanical friction, although it may be expected to increase with the load, is in itself so small that even if it were to increase by 20 or 30 per cent. at full load it would not materially affect the efficiency. As regards hysteresis the case is different. Generally speaking, the loss of power caused by it is of importance, and it is conceivable that this loss may increase with the load, not only by reason of an increase in the strength of the field, but also owing to distortion of the field. Both of these causes affect also the eddy currents, so that we may certainly expect the loss caused by them to increase with the load. Eddy currents occur in the core and in the armature bars only when the intensity of the field changes—that is, under or near the edges of the pole pieces. When the machine is running light the strength of the field at the leaving edge of the pole piece is practically the same as that at the entering edge, and, in fact, the same over the whole extent of polar surface; but when a considerable current flows through the armature bars the field becomes distorted by cross-induction. It becomes weakened at the entering edge and strengthened at the leaving edge, so that every bar while traveling from one edge to the other is passing through a gradually increasing field. In addition to the eddy currents produced at entry and exit only, as is the case when the machine is working light, there are now also eddy currents produced at the intermediate points. The eddy currents at the entering edge have decreased because there the field has been weakened, but those at the leaving edge have increased because there the field has been strengthened; and since the loss of power through eddy currents may be roughly said to be proportional to the square of the field strength, the gain in one place will not suffice to make up for the increased loss in the other, so that, on the whole, we may expect to find the loss by eddy currents increase with the cross-induction—that is, with the load on the machine. What has here been explained applies equally to drum and cylinder armatures, but in the latter there is another source of loss, absent from the former—namely, the influence of the internal winding. The current passing through the internal wires of a Gramme armature produces a field the lines of which are more or less parallel to the diameter of commutation. This field is stationary in space, and its lines are therefore continuously being cut by the spindle, hub, arms, and other metal parts within the armature core. The larger the current passing through the armature, the stronger is this field, and the stronger are the eddy currents produced in these metal parts. The power thus wasted must, therefore, increase with the load. These theoretical considerations are completely verified by experiment, but to make such experiments it is, of course, necessary to determine the losses through eddy currents and mechanical and magnetic friction separately. Various methods exist for making this determination. According to one of them, the field of the machine is separately excited, and the armature is supplied with current at various E. M. Fs. It will, therefore, run at various speeds. If we plot speeds on the horizontal and currents on the vertical, we find that all the points lie on a straight line; and prolonging this line backward, we obtain, by its intersections with the axis of ordinates, that current which will just suffice to keep the armature moving imperceptibly. Call this C_o, the current corresponding to speed *o*. Let *E* be current and E. M. F. at the normal speed *n*, then the total power wasted in running the armature light is $W = C\,E$, and this consists of two parts, namely, the power wasted in friction and hysteresis, which is $W_h = W\frac{C_o}{C}$, and that wasted in eddy currents, which is $W_f = W\frac{C - C_o}{C}$.

* From the *Electrical Engineer* (London).

We neglect, of course, the power lost in armature resistance, which, with a machine running light, is insignificant.

Now, imagine two machines of the same type mechanically coupled and electrically so connected that one acts as motor and the other as generator. We supply current to keep the system in motion, and adjust the E. M. F. so as to get different speeds. By making the proper allowance for armature resistance, we can, from the observed values of speed, armature current, supply current and E. M. F., separately calculate the power lost in eddy currents and hysteresis. It is not necessary to enter into thetheory of such tests here; suffice it to say that the value for W_f thus found is always greater than the W_f determined when running light, and that with W_h this is generally the case.

The Electrical World's Headquarters at the Buffalo Convention.

The Buffalo convention promises to be one of the most interesting winter gatherings that the National Electric Light Association has had since its organization. The programme, printed in full on another page, is a decidedly practical one, the topics to be discussed being those of every day importance to central station men. The Electrical World will be represented, as usual, by a sufficient number of its regular staff to look after the interests of the members and secure a full and accurate report of the proceedings. Two large parlors of the Iroquois Hotel have been secured as the headquarters of The Electrical World during the convention, and an interior view of these is shown on this page. It goes without saying that all those in attendance at the convention will be welcome to call at our rooms.

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Chronological History of Electricity, Galvanism, Magnetism and the Telegraph, from B. C. 2637 to A. D. 1888.—Part I.

BY P. F. MOTTELAY.

A. D. 1797.——Pearson (George), English physician and chemist, communicates to the Royal Society a very interesting paper entitled, "Experiments and Observations made with the view of ascertaining the nature of the gas produced by passing electric discharges through water; with a description of the apparatus for these experiments."

An abstract of the above appears in the *Phil. Trans.* for 1797, and a full transcript of it is to be found in *Nicholson's Journal*, vol. I., pp. 241–248, 299–305 and 349–355.

As Mr. Wilkinson has it, "Dr. Pearson supposes the decomposition of water by electricity to be effected by the interposition of the dense electric fire, between the constituent elements of the water, which he places beyond the sphere of attraction for each other, each ultimate particle of oxygen and hydrogen uniting with a determinate quantity of the electric fire to bestow on them their gaseous form. Hence the doctor supposes that the electric fire, after effecting the disunion, assumes the state of caloric.

"On the reproduction of water by the passage of an electric spark through a proportionate quantity of oxygen and hydrogen gases, Dr. Pearson ingeniously conjectures that by the influence of the electric flame the ultimate particles of these gases, the nearest to the flame, are driven from it in all directions, so as to be brought within the sphere of each other's attractions. In one of these cases Dr. Pearson supposes that the caloric destroys the attraction, which in the other instance it occasions.

"It is with diffidence that I take on me to controvert the opinions of this very respectable physician; but I presume that the whole of the phenomena of the synthesis and analysis of water are more readily to be explained on the principles I have laid down than by the adoption of the mysterious terms of attraction and repulsion. By the operation of galvanism, water is more rapidly decomposed by common electricity. In this operation there is no evolution of dense electrical fire, but merely a current of a small intensity of electricity acting permanently and incessantly. To reproduce water, a flame must be generated sufficient to kindle the contiguous portion of the hydrogen gas, then the next portion, and so on, the combustion being preserved by the presence of the oxygen gas. As these processes proceed with immense rapidity as soon as the gases are intermixed, so as to appear like one sudden explosion, the caloric of each of them being thus disengaged, their bases unite and constitute water."

Dr. Pearson also made many experiments to ascertain the effect of the application of galvanic electricity for the treatment of diseases, and Noad, who describes one of his successful operations, also details ("Manual, pp. 343–349) the observations of many others in the same line, notably those of Drs. Apjohn, Majendie, Grapengiesser and of Wilson Philip, Petrequin, Pravaz, Prevost and Dumas (*Jour. de Physiol.*, tome III., p. 207), as well as of Sarlendière and Dr. Golding Bird, besides giving the very important conclusions arrived at by Stefano Marianini.

See "Some Account of George Pearson," M. D., F. R. S. (*Phil. Mag.*, vol. XV., for 1803, p. 274); letter of Humboldt to Mr. Loder ("Bibl. Germ.," vol. IV., Messidor, An. VIII., page 301); William Van Barneveld," Med. Elektricität," Leipsic, 1787; C. H. Wilkinson, "Elements of Galvanism," London, 1804, 2 vols. *passim*; paragraph No. 328 of Faraday's "Experimental Researches," J. N. Hallé, "Journal de Médicine de Corvisart, etc," tome 1, Nivose, An. IX., p. 351; "Annales de l'Electricité Médicale" *passim;* H. Baker (*Phil. Trans.*, vol. XLV., page 270); "Jour. de la Soc. Philom., Messidor, An. IX.; J. F. N. Jadelot, "Expériences, etc.," 1799; M. Butet ("Bull. des Sç. de la Soc. Philom.," No. 43, Vendémiaire, An. IX.); M. Oppermanno, "Diss. Phys. Med." (See J. G. Krunitz "Verzeichnis, etc."); Andrieux, "Mémoire . . . maladies," Paris, 1824; Lebouyer-Desmortiers (Sue, "Hist. du Galv.," vol. II., p. 420, and *Jour. de Phys.*, Prairial, An. IX., 1801, p. 467); C. J. C. Grapengiesser "Versucher d. Galvanismus, etc.," Berlin 1801 and 1802; the works of J. Althaus, published in London and Berlin in 1859-1870; C. A. Struve's works, published in Hanover and Breslau, 1797-1805; F. L. Augustin's works, published in Berlin, 1801-1803; Karl Friedrich Kielmeyer (Kielmaier) works, published at Tubingen (Poggendorff, vol. I., p. 1,253); Einhoff (Gilb., XII., 230); Francesco Rossi's treatises on the application of galvanism, published in 1809; Gilb. "Ann." vol. XII., p. 450; *Jour. de Phys.*, vol. LII., pp. 391 and 467; Cuthbertson's letter in *Phil. Mag.*, vol. XVIII., p. 358; J. G. Anglade, "Essai sur le Galvanisme, etc." (Sue, "Hist. du Galv.," vol. II., p. 73); Jacques Nauche, in *Phil. Mag.*, vol. XV., p. 368, as well as in Poggendorff, vol. II., p. 256, and throughout the "Journal du Galvanisme."

A. D. 1797.——In the *Reichsanzeiger*, a German publication, No. CCXXII., it is said that a certain person having an artificial magnet suspended from the wall of his study with a piece of iron adhering to it, remarked, for several years, that the flies in the room, though they frequently placed themselves on other iron articles, never settled upon the artificial magnet.

See Cavallo, "Experimental Philosophy," 1803, Vol. III., p. 560, or the 1825 Philad. Ed., vol. II., p. 286.

A. D. 1797–1798.——Reinhold (Johann Christoph Leopold), while Bachelor of Medicine in Magdeburg, tendered for his theses, on the 16th of December, 1797, and on the 11th of March, 1798, two Latin dissertations on galvanism, one of which was offered concurrently with J. William Schlegel, then a medical student.

Numerous extracts from both the above very important papers, which treat extensively of galvanic experiments upon animals, vegetables, metals, etc., will be found at pp. 123–195, vol. I., of Sue's "Histoire du Galvanisme," Paris, 1802. Both dissertations review galvanism from its origin and make mention of many works which had not up to that time appeared in print.

In the first volume of his "Elements of Galvanism," London, 1804, Mr. C. H. Wilkinson devotes the entire chap. VIII. (pp. 188, 260) to Reinhold's able review of galvanism, wherein are first cited Gardiner (author of "Observations on the Animal Economy"), Lughi, Klugel and Gardini as "anterior to the discovery of the doctrine of animal electricity." Then follow accounts of their writings, as well as of those of Galvani and of Volta, "the Prince of Italian naturalists," after which due mention is made, in their proper order, of the observations of Aldini, Valli, Fontana, Berlinghieri, Monro, Fowler, Corradori, Robison, Cavallo, Wells, Havgk, Colsmann, Creve, Hermestaedt, Klein, Pfaff, Ackermann, Humboldt (letters to Blumenbach, Crell, Pictet and Mr. de Mons), Eschenmeyer, Achard, Grapengiesser, Gren, Michaelis, Caldani, Schmuck, Mezzini, Behrends, Giulio, Ludwig, Webster, Vasco, Hebenstreit and others.

The subject of the eighth and last section of Reinhold Dissertations, as Wilkinson expresses it, consists of the exposition of the hypotheses of different authors on the galvanic fluid. These hypotheses he brings into two classes, as they relate to the seat which is assigned to the cause of the phenomena. The first of these classes belongs to the animal which is to be galvanized; and the second to the substance applied to its body, or to the arc. As the galvanic phenomena are ascribed by several physiologists to electricity, Reinhold makes a new division, relatively to the opinion of those who assert that the galvanic and electric fluids are the same, and of those who are persuaded that the former differs from the latter. Under the first head or division he ranges Galvani, Aldini, Valli, Corradori, Volta, in the early time of the discovery; then Schmuck, Voigt, and Hufeland; while under the second come Fowler and Humboldt. Of the latter division he makes subdivisions, in the first of which he comprehends Volta, Pfaff, Wells, Yelin, and Monro, the second embracing Creve and Fabbroni. The other authors, not having openly avowed their opinion, he passes over in silence.

Reinhold is likewise the author of "Versuche um die eigentliche, etc." (Gilb. "Annal." X., 1802, pp. 301–355), "Untersuchungen über die natur., etc." (Gilb. "Annal." X., 1802, pp. 450–481, and XII., 1803, pp. 34–48); "Galvanisch-electrische Versuche, etc." (Gilb. "Annal." XI., 1802, pp. 375–387;) "Geschichte des Galvanismus," Leipsic, 1803; "Versuch einer skizzirten, etc." (Reil. "Archiv." VIII., 1807–1808, pp. 305–354); "Ueber Davy's Versuche," (Gilb. "Annal." XXVIII., 1808, pp. 484–485).

See Schlegel, "De Galvanismo;" Figuier, "Exp. et Hist. des Principales Découvertes," vol. IV., pp. 310, 433; J. W. Ritter, "Beweis . . . . in dem Thierreich . . . ," Weimar, 1796; G. R. Treviranus, 'Einfluss . . . . thier, Reizbarkeit." Leipsic, 1801, and Gilbert's "Annalen," vol. VIII., for the latter year.

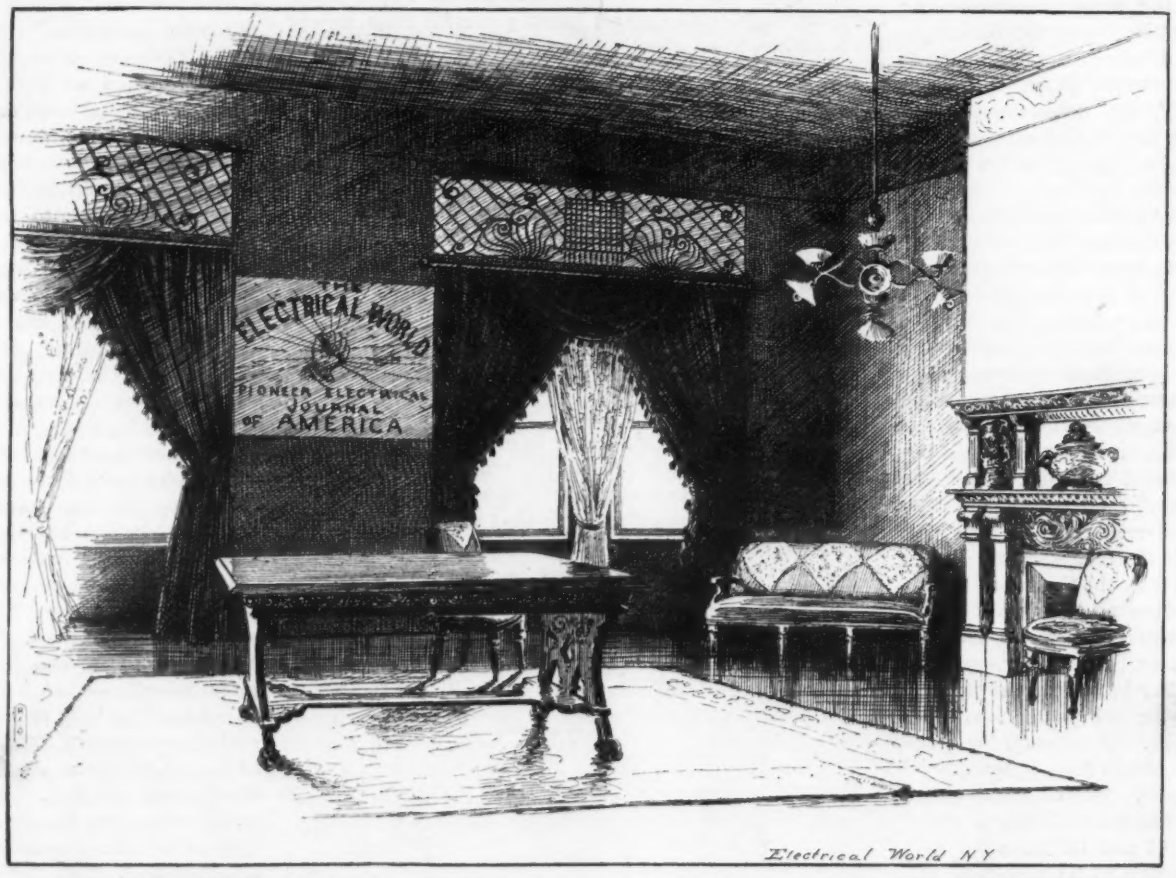
A. D. 1798.——Perkins (Benjamin D.) is given an English patent for a process enabling him to cure aches, pains and diseases in the human body by drawing electrified metals over the parts affected. His metallic tractors, originally introduced from America and consisting of an alloy of different metals, awakened much curiosity both in England and on the Continent, and were successfully used by Dr. Haygarth and others, as related in the article "Somnambulism," of the "Encyclopædia Britannica."

In the Report, ii., 11, 179, it is said that one of the tractors was afterward made of zinc, copper and gold, the other consisting of iron, platina and silver. Mr. V. Burg, in his "Métallo-thérapie," makes a review of the successful cures of nervous complaints effected by metallic applications.

See *Jour. de Phys.*, vol. XLIX., p. 232; Mr. Langworthy, "View of the Perkinian Electricity," 1798; B. D. Perkins, "The Influence of Metallic Tractors on the Human Body . . .," London, 1798-1799; "Recherches sur le Perkinisme, etc." ("Annales de la Soc. de Méd. de Montpellier," vol. XXIX, p. 274); "Sur les tracteurs de Perkins" ("Mém. des Soc. Savantes et Lit.," vol. II., p. 237); P. Sue ainé, "Hist. du Galv.," IV., 286 and "Hist. du Perkinisme," Paris, 1805: J. D. Reuss, "De re electrica," vol. XII., p. 20; J. Keziwaneck, "De electricitate . . ." Prag., 1839.

A. D. 1798.——In a long letter written to Thomas Jefferson, President of the American Philosophical Society, and read before the latter body on the 4th of May, 1798, the Rev. James Madison, then President of William and Mary College, gives an account of different experiments made by him to ascertain the effect of a magnet upon the Torricellian vacuum, and to explain the phenomena exhibited by magnets in proximity to iron filings.

He says: "Many ingenious men have supposed that the arrangement of the filings clearly indicated the passage of a magnetic fluid or effluvia in curved lines from one pole to another of a different denomination," but that the experi-



CONVENTION HEADQUARTERS OF THE ELECTRICAL WORLD, IROQUOIS HOTEL, BUFFALO.

ments which he details prove that the attractive force of the magnets, at either pole, is the real cause of the phenomena which the filings exhibit, and that the action of the magnet upon the filings, when they approach within a certain distance, renders them magnetic. In every magnet, says he, there is at least one line, called the equator, from which, in the direction of both poles, the attractive power increases so that the filings will "incline toward them, forming angles which appear to be such as the resolution of two forces, one lateral and the other polar, would necessarily produce."

Thomas Jefferson, above-named, succeeded Benjamin Franklin as United States Minister Plenipotentiary to Paris, 1784–1789, became Vice-President of the United States in 1796, and was sworn in as the successor of John Adams in the Presidency on the 4th of March, 1801. The Rev. James Madison, D.D., second cousin of the fourth President of the United States, bearing the same name, became President of William and Mary College in 1777, and was consecrated first Bishop of Virginia by the Archbishop of Canterbury in Lambeth Palace, Sept. 19, 1790.

See "Transactions of the Am. Phil. Soc.," vol. IV., for 1799, o. s., No. XXXIX., pp. 323–328.

New Edison Transformers.

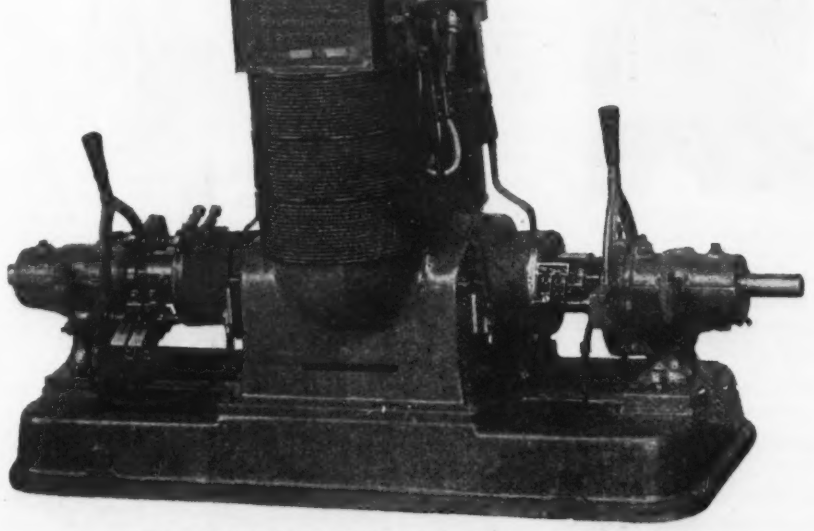
In the accompanying illustration is shown a new Edison continuous current transformer, or motor generator, of especial interest to practical electrical men, on account of the novel features which it presents. This machine has been designed for special use on street railway circuits, and is employed to convert the current from 500 volts on the motor to 125 volts on the dynamo, thus furnishing a current of low tension for either lighting or power.

The motor generator is, in reality, a combination of two machines in one. As its name implies, it is both a motor and a generator. The armature is so wound that it has two distinct windings, and each end is furnished with its commutator, rocker arm and brush holders. The cut shows the appearance and arrangement of one of these transformers, of six kilowatt capacity, the dimensions being those of the standard Edison 12 kilowatt generator, with the exception of the length of the bed plate and pole pieces. The head board at the motor end of the machine is provided with a double pole switch, that at the generator end being furnished with a single pole switch.

If lighting is to be accomplished at a distance from the source of power, as is the case in hilly districts, a turbine and generator wound for a high potential can be placed near a waterfall, to supply electricity to lamps in premises some miles away. In the place of a receiving motor for the high potential current belted to a separate generator, one of these transformers can be employed to take the place of the two machines.

In the case of a street railway station, in which the machines are generating current at 500 volts, it may be found possible to utilize a portion of this current for incandescent lighting purposes. Instead of a subsidiary motor belted to a dynamo wound for 125 volts, or a separate engine and generator, wires are led from the 500-volt machine to the motor generator, and current of the necessary tension for incandescent lamps is produced.

The uses of these machines, however, are not confined to the conversion of high potential current to low tension current alone, as low tension current can be supplied to it and high tension current developed, as is the case in any ordinary transformer. They are manufactured in various sizes and for various voltages—the highest being wound for 1,200 volts on primary circuit.

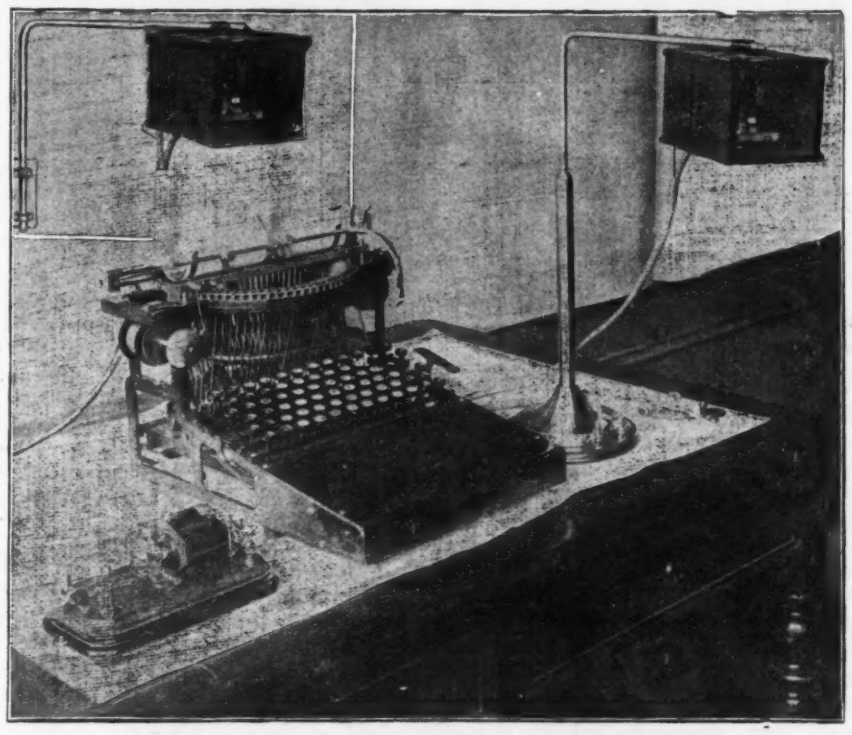


NEW EDISON DIRECT CURRENT TRANSFORMER.

Adjustable Extension Sounder Support and Resonator.

The illustration shows an adjustable extension sounder support and resonator, which is designed for the convenience of receiving telegraph operators using typewriters and for railway telegraph offices where the noise of passing trains may interfere with accurate receiving; also for offices where especially loud and distinct strokes of the sounder are needed. The sounder is of the Bunnell pattern known as the "Giant" sounder, is clamped within a resonant box, which is open at both ends and is sustained in midair by a swivel pendent on a swinging arm. This arm is also adjustable to be raised to, or lowered from, any height within the necessary range, and as the arm also swings laterally on its support the operator can have the sounder wherever it is wanted.

The effect of clamping the sounder within this resonating box is to increase its loudness and distinctness. Under these circumstances no typewriting machine, however noisily it may click or clatter, can interfere in the least with receiving by sound.



EXTENSION SOUNDER SUPPORT AND RESONATOR.

A Combined Switch and Cut-Out.

Electrical switches for breaking currents of both large and small capacities may be divided into two classes. First, those that are required for constant use. Second, those that are but seldom called upon to perform the service for which they are designed. The key socket is a ready illustration of the former, and the huge feeder switch of the latter class. To the first class many new designs are contributed from time to time, but of the latter, the use being to a certain degree limited, but few are well enough known to demand recognition. In the accompanying illustration is shown what is known as the V. V. service cut-out, the invention of Mr. J. H. Van Vleck, the electrician and chief engineer of the Edison Electric Illuminating Company, of New York, for whose special requirements the switch was originally designed.

The fire underwriters in the principal cities require the placing of a switch and cut-out in the main line of every circuit entering a building which can be readily disconnected in case of necessity by the firemen.

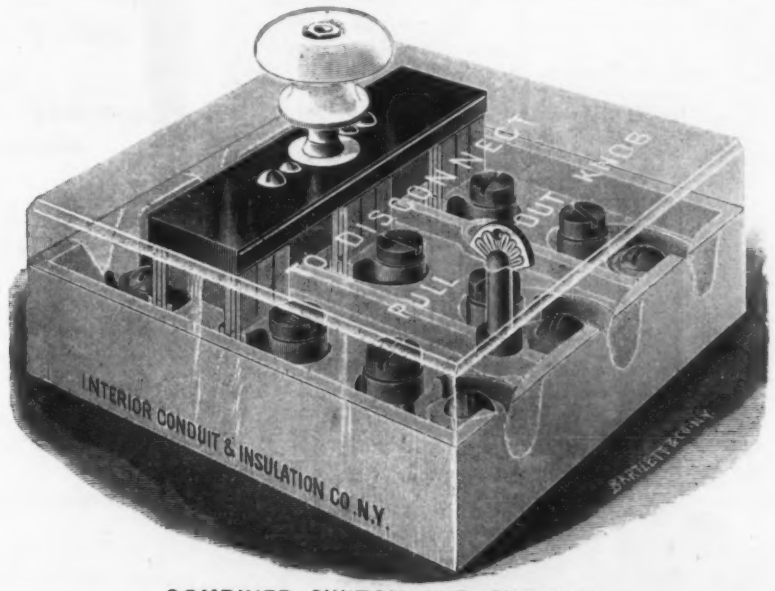
The above switch, combining in a compact form both switch and cut-out, has filled this requirement to the entire satisfaction of the New York Edison and other well known illuminating companies.

In this device the extra cost of the switch arrangement is but a small additional expense over the necessary safety cut-out, so that the combination fills a gap between the conditions where the expense of a regular snap switch and cut-out would be unwarranted, and where a cut-out without a switch would be incomplete.

The switch is constructed wholly of fireproof material; its base and cover being of the best quality of porcelain. It is made for the two and three-wire systems on the plan illustrated, from which it will be seen that one-half of the device embodies the ordinary safety cut-out principle for holding the safety fuses, while in the other half there is a novel form of quick acting snap switch.

The connections are of bronze of ample capacity, with strong screws for the binding posts; the contacts made by means of the plug are admirably fitted, and when the plug is withdrawn to open the circuit the movement is accelerated by means of a strong spring which is contained in the plug itself, insuring a rapid and complete break with a sharp snap action. The only exposed portion of the plug is finished hard rubber, the whole presenting a neat and attractive appearance.

The use of this appliance is, however, by no means limited to the above particular purpose, but is offered by the Interior Conduit and Insulation Company, of New York, for general use as the best and cheapest three-wire main line cut-out and switch for general wiring in the market.



COMBINED SWITCH AND CUT-OUT.

Electric Lighting in the New Jersey State Capitol Buildings at Trenton.

One of the most elaborate and complete isolated electric light plants in the country has lately been placed in the New Jersey Capitol buildings at Trenton, by the Edison General Electric Company of New York, under the personal supervision of Mr. H. P. Dodge, of that company. The plant consists of two 45 kilowatt standard Edison 125-volt dynamos and is arranged on the two-wire system. Located singly and in groups and in very elaborate electroliers are 1,800 incandescent lamps of 16 c. p. each. There are also four Ward arc lamps.

The wiring of this building has been done with the greatest care and in the most modern manner, being concealed throughout in interior conduit tubing.

In closets and in the halls pockets have been cut into the solid stone, in which very neat switchboxes have been constructed and the switches grouped in the most convenient way, so the various rooms can be lighted up without going into them. The switches are so arranged that the lights can be thrown on in sections, making it partially or wholly lighted, as occasion may require.

In the engine room there is a 150-h. p. improved Ball automatic high speed engine, and two boilers installed under the supervision of Mr. E. Baxter, one of the company's engineers. This engine was built by the Ball & Wood Company, of New York, and operates the two dynamos.

Two additional boilers were put in by the Edison company for the steam heating system of the building, the entire work being done under one contract.

What is said to be the longest electrolier in the world is in the rotunda of this building. It is 87 feet from top to bottom, and carries the equivalent of 65 16-c. p. lamps, being built up with three tiers, having 33 16-c. p. lights on the lower, 16 on the second, and eight 32-c. p. lamps on the upper row. Its trimmings are of the most expensive style. There will be another of these in the new Assembly chamber, not quite so long, but of a more costly design, and with a greater number of lights, the total being 96.

The plant is completed and has been opened to the public for several weeks. It is considered one of the finest isolated plants in the State, and the thoroughness of the work reflects great credit upon Mr. Dodge, who superintended it.

A New Lamp Guard.

There are many new places where it is desirable that the lamp be protected in some manner. The illustration shows an incandescent lamp guard having several original features. It is made of flat wire with the edges placed outward, giving it an extremely strong frame; at the same time it throws but little shadow, or no more than the ordinary guard. The collar is made adjustable and will fit any socket. It keeps the guard rigid with the socket so that if it accidentally swings against anything it will not bend over and break the lamp. The bottom is open and the

Lamp Guard.

lamps can be taken out and replaced without the trouble of removing the guard. It is manufactured by The Electrical Supply Company, Chicago.

Queen & Co's New Thomson Reflecting Galvanometer.

In designing this instrument four qualities were aimed at: 1st, maximum insulation of the strictly electrical portions of the instrument; 2d, maximum sensitiveness; 3d, application to a wide range of uses, and 4th, convenience in adjustment and quickness in working.

The entire framework of the instrument, to which are fastened the coils proper, has been supported by two highly polished corrugated rubber pillars, each 3½ inches in height, the corrugations so increasing the insulating surface of the pillars as to make them each equivalent to a plain pillar 7 inches high. The terminal binding posts of the coils are so arranged that they go direct to the coils themselves without touching the base or outside case of the instrument. To effect this, these posts are attached to the ends of four long rods about 3-16 of an inch in diameter; these rods pass down through holes in the top of the case to brass lugs attached to the coil frames proper. Into these lugs, which form the terminals of the coils, the four rods screw. The holes in the top of the case through which the rods pass are somewhat larger than the rods themselves; a small hard rubber collar fits over these rods and slips down over them so as to fill these holes when the instrument is not in use,

Queen & Co.'s New Galvanometer.

thus keeping the dust out; when the instrument is to be used these collars are slipped up, thus leaving the binding post rods entirely insulated from the case by an air space.

To secure maximum sensitiveness the upper and lower sets of coils have been separated a little more than usual and the mirror placed between the coils. This allows the conical space usually left in the upper coil (to allow the reflected ray to go to one side or another of the normal) to be completely filled with wire.

The coils are so arranged that they can be easily taken off and replaced by others of a lower or higher resistance.

In place of the box level are two hermetically sealed and brass encased spirit levels set at right angles to one another.

Other portions of the instrument are much the same as in the usual patterns. A control magnet is arranged to slip up or down the tube and has a delicate tangent screw which may be rotated about the central axis of the instrument.

Messrs. Queen & Co. also have a new and improved tripod galvanometer lately made which they are now testing and which they hope to be able to place before the public very shortly.

The Davis Police Signal System.

In the illustrations are shown two forms of the Davis police signal system, by which when an officer sends a call from any street box, even if he be off from his own "beat,"

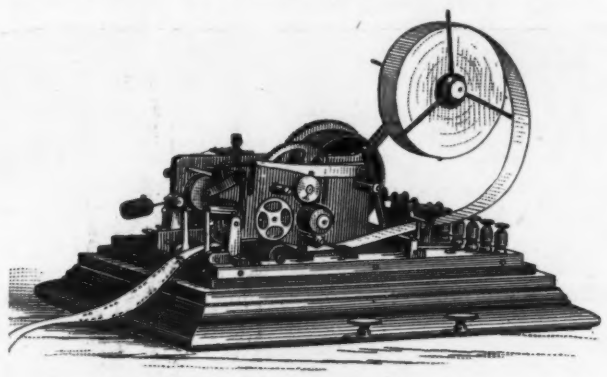


Fig. 1.—Davis Police Signal.

he is identified at once at the central office by a special number which is recorded on telegraph paper. Each member of a police force is provided with a key and corresponding number, which is registered at police headquarters, and when the key is inserted by an officer in the signal box, Fig. 2, the simple act of turning it winds up the mechanism and sends in to the station with which it is connected the number of the box, the number of the officer, the time, hour and minute, all of which are automatically registered in print at the station by the register shown in Fig. 1. This entire operation is accomplished by the simple insertion of the key, turning it, and immediately withdrawing it. A citizen's key will not open a box. When an officer wants a "wagon," "extra officers," to speak with an officer at the police station by telephone, or to report a "fire," he simply opens the door of the box and pulls down the lever against the signal he wishes to send. This is a new departure in police signaling, and it is claimed has many advantages over the old style systems, as it gets rid of the dial, the pointer to be set, and all the break wheels and electrical contact devices of the old system except a single one, thereby greatly simplifying the mechanical and elec-

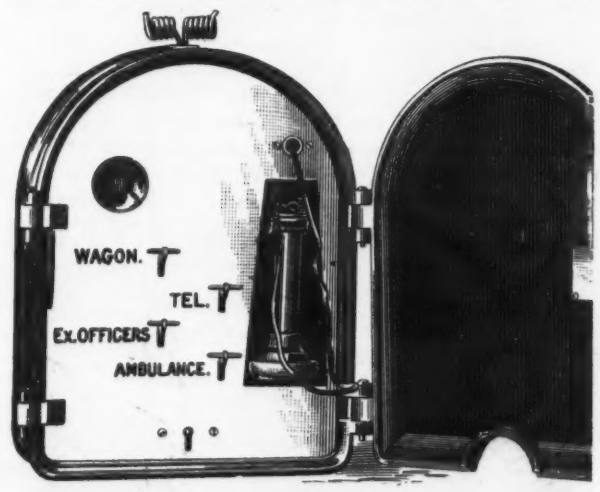


Fig. 2.—Davis Police Signal.

trical construction, and lessening the liability to get out of order as well as insuring the greatest reliability in sending signals correctly. The system is controlled in New York City by Mr. J. H. Howard, of 95 Broad street, where it can be seen in practical operation.

A Proposed State Board of Electrical Control.

A bill for the regulation of the use of electricity has been introduced in the Senate. Its object is to create a State board of electrical control and to define its powers and duties, and embodies the results of a Senate investigating committee. The bill provides for the appointment of three commissioners, at a salary of $6,000 a year, and a staff of clerks and inspectors. One of the commissioners must be a Republican and the other a Democrat. The politics of the third may be independent. Power is given to the commission to administer oaths and issue subpœnas. The bill also enumerates the following:

1. To adopt reasonable rules and regulations relative to the insulation of electrical conductors, the mode of constructing poles for the carrying of the same and the manner of placing of electrical conductors thereon; the character and construction of underground subways and the placing of electrical conductors underground generally; the construction and placing of converters or transformers used in electric lighting; the relations between the various classes of conductors carrying currents of different tensions in the same city, town or incorporated village; the adoption and use of reasonable safety devices and appliances, and generally regarding the construction, maintenance and repair of the plants and apparatus of the various companies engaged in the business of distributing electricity for commercial purposes throughout the State so far as shall be necessary to secure safety to the public.

2. To devise and carry into effect independently or with the aid of local authorities in cities having a population of one hundred and twenty-five thousand inhabitants or more, plans for the removal of overhead electrical conductors and replacing the same by underground conductors.

3. To examine, or cause to be examined by properly qualified examiners and grant licenses to persons qualified to take charge of or act as electrical experts or engineers to companies or persons engaged in the business of distributing electricity for commercial purposes.

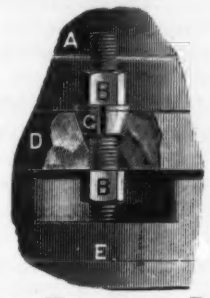


Fig. 1.—Blank Holder for Drawing Press.

4. To examine into the circumstances of any death or accident to person or property caused by electrical currents, giving to the person or corporation concerned in or affected by such examination due and reasonable notice to appear and be heard.

5. To inspect new installations for generating and distributing electricity throughout the State, and grant certificates to the effect that the same are in accordance with the rules and regulations of said board.

The bill abolishes the Board of Electrical Control of New York City and the Board of Commissioners of Electrical Subways of Brooklyn, and gives their powers to the State board created by it. The total annual expense of the board must not exceed $60,000 a year, and in the language of the bill, this expense "shall be borne and paid by the various companies engaged in the business of distributing electricity for commercial purposes within the State, including all telephone and telegraph companies, companies distributing electricity for the purpose of furnishing heat, light, or power, companies operating street cars, or other public conveyances by means of electricity, district telegraph or messenger companies, and burglar alarm or fire alarm companies."

Toggle Drawing Presses.

Many radical improvements have been made in presses of this form, which have brought about a change in the construction and in the minor details. The illustrations show the toggle double action press and a blank holder adjusting plate. A change which has been made in the construction which is noteworthy is the perfecting of an arrangement for operating the blank holder by means of toggles, which entirely dispenses with cams, and this improvement, it is claimed, increases the simplicity, durability and smoothness of action as compared with the old style presses. In the matter of weight and strength of

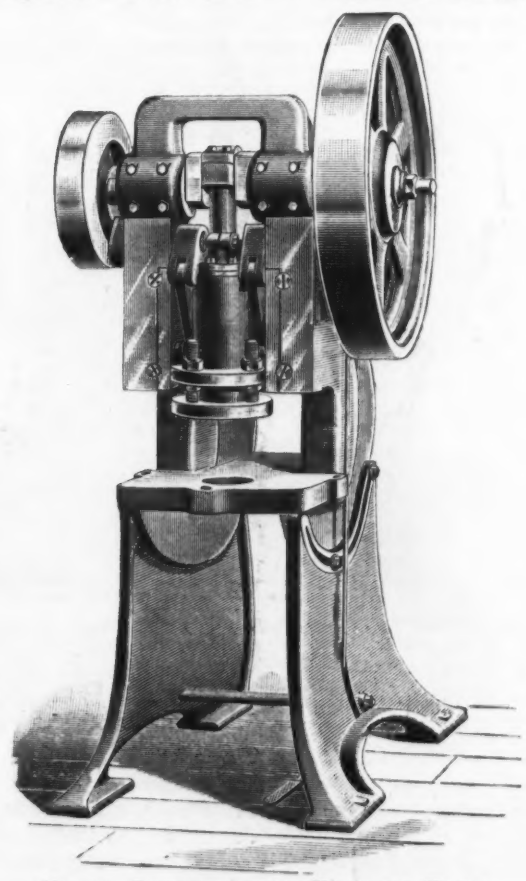


Fig. 2.—Double Action Drawing Press.

parts, the same has been increased so that each press now constructed is equal to the next larger size as formerly built.

These presses are adapted for making blacking boxes, baking powder cans, lard pail covers, round, oval, square and oblong tin boxes for chemicals, powders, tobacco, etc., burners, lantern parts, gas fixtures, curtain pole ends, sleigh and gong bells, cane heads, ferrules and cartridge shells.

They are manufactured by E. W. Bliss & Co., Limited, of Brooklyn, N. Y.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Feb. 15, 1892.

The stock market of the past week has centered principally on specialties. The regular list has been rather neglected and all interest has been directed toward a few stocks, which have been particularly active on account of new deals for consolidation that have just been consummated. The activity of these few stocks, notably the electrics, has leavened the entire market and imparted a strength and upward movement to all the others. The conditions during the week were far more satisfactory to both investors and traders than during the previous week. The bearish elements, which have recently held the balance of power and counteracted the natural rallying powers of the market, rapidly disappeared last week and the other side held full sway. The lack of strength and low prices of the past few weeks have been due largely to the inactivity of general trade and the burden of enormous reserve funds on the money market. The effect of this overloading has been directly in opposition to active speculation in stocks. The condition in this particular was improved during last week and money is again moving along in its natural channels and more readily finding customers at reasonable rates. The supply still exceeds ordinary demands, but is not so large as to be cumbersome. During the first part of the week rates were a little firmer than previously, but the change was only temporary and without foundation. Call money is available to good borrowers at three to four per cent., and with the best collateral it can be had at even two and a half per cent. Commercial paper is worth fr om three and a half to five per cent. These low rates are the best criterion by which to judge of the money market. We note also a rise in sterling exchange of one-half and this brings it very near the exporting point, and causes some uneasiness on account of the limited supply of gold on hand at present.

The details of the Edison-Thomson-Houston combination have already been published. The final adjustment of the terms were agreed upon on Tuesday, the 9th, and the papers bear that date. The stocks must be deposited by April 15, according to the terms of the agreement of consolidation, and the agreement will be operative upon the deposit of a majority of both companies' stocks. Since the Thomson-Houston company has $4,000,000 of common and $1,000,000 of preferred stock still unissued, and which it has a right to issue to make the entire capital $15,000,000, the question naturally arises as to whether the stockholders may not yet have some further privileges before the consolidation is completed, in the form of a stock dividend, or even a right to subscribe to an issue of the new stock at par. Rumors to this effect come from reliable sources, and it may be put down as within the range of possibilities.

Stockholders of the North American Company, the successor of the Oregon Transcontinental Company, are beginning to wonder if the new deal will not have a good effect on their stock. It is fresh in the memory of all who are posted in electrical matters what this company was going to do by combining the interests of the principal electrical companies. That plan failed to accomplish anytting whatever. It is supposed that the company purchased at the time of those negotiations a considerable amount of stock of the Edison General Company and certain local companies, and these should make its property of good value now.

Sales of the Week.—During the week Thomson-Houston sold up to 62½ and about 25,000 shares were traded in. Edison stock sold as high as 109, the sales amounting to upward of 10,000 shares. The movement of prices of the two stocks seemed to indicate that New Yorkers have sold Edison to buy Thomson-Houston. The latter was recently selling at 58, and the other at 109, and the next day Edison was offered at 100, and active buying put Thomson-Houston to 62, and it was bought by some of the largest houses in New York.

The Westinghouse Electric Company.—Referring to the affairs of this company, Rialto in the Boston *Advertiser* recently stated that "during the past year the Westinghouse company, instead of spreading itself in efforts for new business, has been quietly getting itself upon a most sound and conservative financial basis. It has inaugurated many economies at its factories and its business methods, making sweeping reductions in salaries and in its numerous agents in all departments, and has to-day the most improved and labor-saving machinery. The result has been that the net profits have increased if not exceeded the possible deficiency in gross business. The debt has been rapidly paid up. The leased companies, the Consolidated Electric (which included the Sawyer-Man Company) and the United States company have been placed under the management and consolidated with the Westinghouse Electric Manufacturing Company. Under this arrangement the new preferred stock was issued to the extent of about $4,000,000, which is entitled to seven per cent. cumulative dividends, while the old stock has been reduced 70 per cent., thus making the present capitalization, both common and preferred, $10,000,000, of which quite a large portion is in the treasury. The talk of consolidation with the other electric companies is now pronounced, and while there are conflicting statements from people in various positions of authority, the general sentiment seems to be that Westinghouse stands in a preferred position. If consolidated it will make the new company complete. If not taken in it will secure all the advantages of consolidation without making any concessions. It is claimed by the Westinghouse people that in its present position that company can manufacture cheaper than anybody else in the country and still make a large profit."

Among recent auction sales were Lynn (Mass.) Gas and Electric Company's stock at 160, Brockton (Mass.) Street Railway bonds at 100⅛, and Boston Electric Light Company's bonds at 105½.

Bonds to Be Issued.—The United Electric Securities Company, which recently sold by subscription $1,700,000 worth of its five per cent. bonds, will issue the second $500,000 lot in a few days. Only one-half of the subscription was issued at the time of the sale.

Increase in Capital Stock.—The following companies have increased their capital stock: The Moundsville, W. Va., Electrical Company has increased its capital stock by $10,000; the directors of the Consolidated Street Railway, Worcester, Mass., have voted to issue at once the additional $350,000 capital stock for which permission was recently granted by the Legislature. The stockholders are entitled to purchase at par as many shares of the new stock as they now possess of the old, on condition that they do so before March 15. The shareholders of the National Electric Tramway and Lighting Company, of Victoria, B. C., at a recent meeting voted to issue $100,000 in additional stock at par $10 per share.

Annual Reports.—The Sandy Hill, N.Y., Electric Light and Power Company, Limited, in its annual report of January, 1892, shows capital stock $24,500, all paid in; assets at least equal to $16,000; debts not exceeding $5,000. The annual report of the National Electric Tramway and Lighting Company, of Victoria, B. C., showed a credit of nearly $19,000, with receipts for the past year $78,000. The Albany (N. Y.) Railway Company, in its report for the quarter ending December 31 contains the following statistics: gross earnings from operation, $54,156; operating expenses, $30,828; net income from operation, $23,328; other expenses, $10,937; net income from all sources, $12,390. During the same period of 1890 there was a net deficiency of $66,393. Cost of road and equipment, $1,355,213; cash on hand, $10,334; capital stock, $750,000; surplus, $2,115. The Troy (N. Y.) & Lansingburgh Electric Street Railroad, for the quarter ending Dec. 31, shows the following: Gross earnings from operation, $95,813; operating expenses, excluding taxes, $56.737.83; net income, all sources, $32,004; cost of operating, including taxes, 61.19 per cent. The corresponding quarter in 1890 returned gross earnings, $89,738; net income, $13,393. The Thomson-Houston Electric Company in its annual report, it is stated, will show net earnings of $3,000,000, and about $1,500,000 cash on hand at the close of the fiscal year. The annual report of the Edison General Electric Company is given elsewhere in this issue.

Closing Quotations.—The following were the closing quotations of electric stocks on Saturday, Feb. 13, 1892, in New York and Boston:

NEW YORK QUOTATIONS.

Name of Stock.	Par.	Capitalization.	Bid.	Ask'd.
Western Union Telegraph Co	100	86,200,000	86⅛	86⅜
Commercial Cable Co	100	7,716,000	149½	150½
Edison General Electric	100	15,000,000	101½	102
Consolidated Electric Light	100	2,500,000	20	30
Edison Illuminating Co., of New York	100	4,500,000	81½	82
" " " Brooklyn	100	750,000	74	78½
" " " Chicago	100	750,000	138	142
U. S. Illuminating Co	100	1,250,000	30	35
Edison Elec. Light Co. (of Europe) stock	100	2,000,000	2½	5
" " " " bonds	sh	30,000	65	75½
" Ore Milling Co	100	2,000,000	17½	22½
" Toy Phonograph Mfg. Co	10	1,000,000	....	½
U. S. Electric Light Co	100	1,500,000	15	20
Brush Illuminating Co., of New York	50	1,000,000	40	50
Mt. Morris Electric Light Co		500,000	....	60
East River Electric Light Co	100	1,000,000	....	60
North American Phonograph Co	...	6,600,000	4½	6
New York Phonograph Co	...	2,000,000	3	4
Automatic Exhibition Co	...	2,000,000	2	2½
New England Phonograph Co	...	2,000,000	1¾	2¾

BOSTON QUOTATIONS.

	Par.	Capitalization.	Highest.	Lowest.	Bid.	Ask'd
Thomson-Houston Elec	25	6,000,000	62½	59¼	60	60¾.
Thomson Houston Elec. preferred	25	4,000,000	29¾	28¼	28¼	28¾
Thomson-Houston Elec.—Series C	sh	40,000	5	....	8¼	9
Thomson-Houston Elec.—Series D	sh	120,000	8	7⅝	7½	7⅞
Thomson-Houston Int'n'al Elec	100	600,000	....	....	200	220
Thomson-Houston Int'n'al Elec—Pfd	100	400,000	....	....	102	104
Thomson Elec. Weld	100	1,000,000	....	....	55	....
Thomson European Elec. Weld	100	1,500,000	....	....	12½	15
Westinghouse Elec.—Pfd	50	10,000,000	24¾	24	24	24½
Westinghouse Elec. — Trust receipts	..	...	16¼	14¼	14½	15
Fort Wayne Elec	25	4,000,000	14	13½	13⅝	13¾
Fort Wayne Elec.—Ser A.	sh	80,000	7¼	7⅛	7⅛	7¼
Detroit Elec	10	1,0 0,000	8	7¾	7¾	8
West End St. Ry. Co.—Com	50	7,150,000	73½	73	72¾	73
West End St. Ry. Co.—Pfd	50	6,400,000	84½	....	84½	85
American Bell Tel	100	15,000,000	210	209	209½	210
Erie Tel. & Tel. Co	100	...	44	....	44	....
Mexican Tel. Co	..	...	105	....	105	110
New Eng. Tel. & Tel. Co.	100	...	50½	...	50	51
Tropical Tel. Co	..	...	30	....	30	..

*Ex-dividend

Chicago Quotations.—Col. S. G. Lynch, broker, 153 Monroe street, Chicago, furnishes quotations on electrical stocks as follows:

TELEPHONE STOCKS.

Chicago	$227@	$229	Cumberland	$60@	$62
Central Union	54@	56	Wisconsin	118@	120
Michigan	81@	83	Bell of Missouri	175@	180
Great Southern	30@	32	Iowa Union	20@	22
Colorado	34@	36	Missouri & Kansas	51@	53
Rocky Mountain Bell	40@	43			

ELECTRIC LIGHT STOCKS.

Chicago Arc Light and Power	$87@	$89	Chicago Edison Co	$140@	$142

NEW INCORPORATIONS.

The Ithaca Electric Lighting Company, of Ithaca, Mich., capital stock $20,000, has been formed to produce and sell electricity for lighting, etc. J. B. Crawford, I. J. Heath and M. F. Chafey, all of Ithaca, are the incorporators.

The Constantine Electric Company, of Constantine, Mich., with a capital stock of $6,000, has been formed to make and supply electric light and power. Levi Hull, Franklin Wells and John Proudfit, all of Constantine, are the organizers.

The Springfield Electric Light Company, of Springfield, Ore., with a capital stock of $10,000, has been incorporated to furnish electric light. J. C. Boyd, Geo. H. Thurston, B. J. Pengra, A. Mande and M. L. Wilmot, all of Springfield, Ore., are the promoters.

The Lebanon & Myerstown Street Railway Company, of Lebanon, Pa., with a capital stock of $100,000, has been formed to operate an electric street railway. S. L. Brightbill, of Annville; Jacob M. Shenck and E. H. Brooks, of Lebanon, Pa., are the promoters.

The Freeman Holland Company, of Portland, Me., with a capital stock of $500,000, has been organized to manufacture and deal in electrical appliances of all kinds. E. W. Freeman, of Portland, Me., and Dwight S. Woodworth, of Boston, Mass., are the promoters.

The Arlington Heights Electric Light Company, of Forth Worth, Tex., capital stock $100,000, has been incorporated to supply light, heat and electric motor power to the public. Those interested are H. W. Fallant, W. C. Winthrop, Robert McCart and G. B. Paxton.

The Quinsigamond Electric Power and Light Company, of Worcester, Mass., with a capital stock of $10,000, has been formed to produce and sell electricity for light, heat and power. Horace H. Bigelow, Irving E. Bigelow and Eben F. Thompson are the incorporators.

The Negaunee & Ishpeming Electric Light Company, of Negaunee, Mich., capital stock $20,000, has been incorporated to supply Nagaunee and Ishpeming with electric light. Alex. Maitland, Negaunee, Mich.; John B. Mars, of Negaunee, Mich.; H. O. Young, and J. Jones, Ishpeming, are the incorporators.

The Eldora Electric Light Company, of Eldora, Ia., with a capital stock of $15,0 0 has been formed to erect, maintain, own and operate an electric light plant at Eldora, Ia. W. S. Porter, C. E. Albrook, J. H. Smith, C. E. Green, J. F. Hardin, J. D. Newcomer and E. K. Brown, all of Eldora, Ia., are the incorporators.

The Lincoln Street Railway Company (Consolidated Lincoln Street Railway Company and Rapid Transit Company), of Lincoln, Neb., capital stock $2,300,000, has been formed to construct and maintain electric railways in Lincoln, Neb. T. W. Little, C. C. Upham and C. F. Earnest, all of Lincoln, are the promoters.

The Dallas Electric, Telephone and Power Company, of Dallas, Ore., with a capital stock of $40,000, has been formed to purchase, build, equip, operate and maintain an electric light plant in and for Dallas City, Ore. G. V. Bolton, H. C. Wilson, Geo. C. Blakeley and George Rich, all of Dallas, are the incorporators.

The Dayton Auxiliary Fire Alarm Company, of Dayton, O., with a capital stock of $30,000, has been organized to install and operate auxiliary fire alarm devices and to operate and deal in other electrical supplies and appliances. The organizers are Jno. F. Ohmer, Jno. P. Breen, A. B. Ridgway, A. L. Bauman and Harry F. Nolan.

The Universal Printing Telegraph and Signal Company, of New York, capital stock $100,000, has been organized to acquire and deal in electrical signals, telegraphs and railroad signals. Jno. H. Bradford, 153 Fifth avenue, New York, C. Fellows, Morristown, N. J., and D. H. Bates, 661 Fifth avenue, New York, are the incorporators.

The Hartford Insulating Company, of Hartford, Conn., with a capital stock of $75,000, has been formed to manufacture and deal in all goods pertaining to the use of electricity, to insulate and manufacture fireproof and waterproof goods, also enamel goods of all kinds. G. Wells Root, Erastus S. Root and F. E. Fowler, all of Hartford, Conn, are the promoters.

Ogden Electric Power Company (incorporated in West Virginia), with its principal office in New York City, and a capital stock of $500,000, has been formed to prosecute a general mining and smelting business and to erect an electric light plant, etc. Those interested are W. S. Morrow, of Westfield, N. J.; J. W. Snedeker, of Bloomfield, N. J., and J. A. Kitten.

The Robinson Motor and Battery Company, of Portland, Me., with a capital stock of $500,000, has been started to manufacture and deal in all kinds of electrical machinery, etc., batteries, cars, motors, dynamos, etc. The incorporators are Matthew H. Robinson, Orlando A. Foster, both of Boston, Mass., and Webster G. Langmaid, of Watertown, Mass.

The Electric Automatic Appliance Company, of Hartford, Conn., with a capital stock of $20,000, has been formed to manufacture, sell, buy and deal in all kinds of mechanical and electrical appliances adapted to steam engines, steam boilers, water wheels, etc. M. W. Terrill, of Middlefield, Conn., H. T. Sperry and J. A. Spalding, both of Hartford, are the organizers.

The Everett Gold Mining and Milling Company, of Tacoma, Wash., capital stock $1,000,000, has been incorporated to do general mining business, operate mills, etc., also railways, tramways, electric light and gas works, etc. The promoters are Henry Hewett, Jr., and Jno. F. Plummer, Tacoma, Wash.; J. F. Wardner, Fairhaven; F. W. Dunn and L. W. Getchell, of Seattle, Wash.

The Colby Specialty Supply Company, of Chicago, Ill., with a capital stock of $100,000, has been formed to invent, manufacture and sell, also lease and otherwise operate various electrical mechanical devices, applications and chemical products, and to sell and lease territorial rights and United States and foreign letters patent. Edward J. Colby, Albert J. Fisher and Harry Fox are the organizers.

The Ryan & Macdonald Construction Company (incorporated in West Virginia), principal office at Baltimore, capital stock $600,000, has been formed to construct a railroad to be operated by steam, electricity, traction or other power, also constructing wharves, telegraphs, etc. C. J. Ryan, of New York City, and J. B. Macdonald and P. W. Briggs, both of Baltimore, Md., are the incorporators.

The Mitchell Electric Company, of St. Paul, Minn., with a capital stock of $15,000, has been formed to construct and operate an electric plant, deal in electricity, and repair all necessary apparatus used in connection with the utilization of electricity, and to lease, purchase and sell, etc., real estate. H. M. Byllesby, H. C. Levis, W. Bromhall, B. T. Meek, Jr.; W. P. Johnson, C. K. Stearns and S. P. Wells, Jr., all of St. Paul, are the organizers.

The Northern Electric Subway Company, of Duluth, Minn., with a capital stock of $100,000, has been started to construct and operate plants and manufacture and deal in electrical appliances for producing light, heat and power; and to construct and operate subways, conduits, pipes, mains and poles and all necessary appliances. N. J. Miller, C. R. Haines and R. M. Hunter, all of Duluth, Minn., are the incorporators.

The Pioneer Carriage Company, of Seattle, Wash., with a capital stock of $10,000, has been formed to manufacture and deal in street cars and other cars and goods, wares or material used in the construction and equipment of street railroads, electric street railroads, telephone and electric light wires and plants, wagons, buggies, etc., and necessary real estate and buildings. The promoters are Fred. E. Sander, J. W. George and L. D. Bruns, of Seattle, Wash.

The Central Gas Light and Water Company, of San Francisco, Cal., capital stock $300,000, has been started to deal in and operate water-works in the San Joaquin, also gas and electric light plants, mills, timber lands, grain, warehouses, wells, personal property, franchises, stock, patents, real estate, etc. Chas. O. Buckland, of Lodi, Cal.; W. J. Phillips, of San Francisco; S. T. Dodson, Sr., of Oakland; T. B. Key, of San Francisco, and S. T. Dodson, Jr., of Oakland, are interested.

AFFAIRS OF THE COMPANIES.

The Ball Electrical Illuminating Company, of New York, will hold a special meeting Feb. 29, for the election of trustees, etc.

The Concord (N. H.) Street Railway Company has elected the following officers: President, John H. Albin; clerk, N. E. Martin; treasurer, Edgar C. Hoague.

The Fitchburg Gas and Electric Company, of Fitchburgh, Mass., has transferred its construction and supply business to A. H. Kimball & Co., who will carry on the same in connection with their general electrical work.

The Illinois Electric Material Company, of Chicago, which was incorporated about two years ago with a capital stock of $15,000, has assigned to Frank Hamlin. The assets of the company are placed at $10,000 and liabilities at the same amount. It is stated that its affairs have been tied up in heavy contracts to such an extent that it has not been able to meet maturing obligations.

The Troy (N. Y.) Telephone and Telegraph Company has elected the following directors: George P. Ide, W. C. Humiston, C. A. Boutwell, William S. Earle, Charles H. Erwin, C. A. Tinker A. N. Belcher, David B. Parker, C. J. French. The directors re-elected the following officers: George P. Ide, president; W. C. Humiston, vice-president; A. N. Belcher, secretary and treasurer.

The Negaunee & Ishpeming Street Railway Company, of Ishpeming, Mich., at a recent meeting of the stock-

holders elected the following board of directors and incorporators to represent the electric light company: Alex. Maitland, J. B. Maas and Samuel Mitchell, of Negaunee; H. O. Young, Fred. Braastad and J. Jones, of Ishpeming, and Peter White, of Marquette.

The Consolidated Electric Company, of St. John, N. B., has elected the following officers: F. J. Zebley, president; H. B. Zebley, secretary-treasurer; C. D. Jones, manager; J. D. Purdy, superintendent of railway and cashier. The directors chosen were: John F. Zebley, S. Hayward, Joseph Bullock, C. P. Clarke, Geo. W. Jones, C. H. Dearborn, Joseph F. Merritt, W. Watson Allan, Geo. M. McLeod.

Sale of an Electric Railway.—The property of the Saratoga, N. Y., Electric Railroad was sold at public auction, recently, under judgment of foreclosure in favor of the American Loan and Trust Company. There were two bidders: Colonel G. P. Lawton and C. E. Arnold. The latter purchased the property for $35,000. Mr. Arnold represents the Union Electric Railroad of Saratoga, which will run a line to the lake.

The Tacoma & Edison and Point Defiance street railway companies have been consolidated under the name of the Point Defiance, Tacoma & Edison Railway Company. The capital stock of the company is $500,000. The following are officers of the new company: R. F. Radebaugh, president; Stuart Rice, secretary. A new electric power house will be erected and other improvements made in the lines.

The Lebanon & Myerstown Street Railway Company, of Lebanon, Pa., has applied to the State Department for a charter. Capital stock, $100,000. The following are the directors: J. M. Shenk, Lyman Nutting, Thomas Evans, E. H. Brooks, H. H. Light C. Shenk, H. H. Kreider, S. L. Brightbill and Adam Behney. The following officers have been elected: Jacob M. Shenk, president; Samuel L. Brightbill, secretary; George D. Rise, treasurer; Charles H. Killinger, solicitor.

The Commercial Electric Light and Power Company, of Tacoma, Wash., has elected the following officers: Frederick Mottet, president; Chester Thorne, vice-president; L. G. Bigelow, treasurer; Robert Sale Hill, secretary and manager; trustees, Frederick Mottet, Chester Thorn, Theodore Hosmer, M. G. Denton and L. R. Manning. Theo. Hosmer is president of the Tacoma Light and Water Company, and it has been expected of late that his company would obtain control of the commercial company.

The annual election of trustees of the Watervliet Railroad held in Albany resulted in the following choice: Charles Newman, James B. Jermain, John J. Acker, J. W. Tillinghast, J. Howard King, A. N. Brady, Ledyard Cogswell, Thomas A. Knickerbocker and William Bayard Van Rensselaer. The inspectors were William A. Cassidy and John Newman. Already the required number of shares have declared in favor of leasing the Watervliet to the Albany road. A new board of trustees will be elected next month which will represent the new managers of the property.

At a recent meeting of the Mather Electric Company on Feb. 9, the following officers were elected: H. G. Cheney, Robert Cheney, U. T. Pulsifer, Wm. A. Anthony, M. S. Chapman, M. M. Kimball and Adams S. Claflin, as directors; president, H. G. Cheney; vice-president, M. S. Chapman; treasurer, U. T. Pulsifer; secretary, Robert Cheney, and for general manager A. D. Claflin. The principal office of the company will hereafter be at 116 Bedford street. Boston, Mass. The factory will remain at Manchester, Conn.

The East End Electric Light Company, of East End, Pittsburgh, Pa., at its annual meeting elected the following directors: J. H. Willock, E. H. Myers, H. C. Bughman, John S. Scully, George H. Blaxter. The following officers were elected for the ensuing year: James H. Willock, president; E. H. Myers, vice-president; H. C. Bughman, secretary and treasurer, and G. P. Shane, manager. The annual report showed an increase of business, both in the aggregate and net profits, of about 20 per cent.

The Sandy Hill Electric Light and Power Company (Limited), of Sandy Hill, N. Y., at its annual meeting, elected the following directors: Marcus C. Allen, Charles T. Beach, John J. Cunningham, John H. Derby, J. Edward Howland, Grenville M. Ingalsbe, Sylvanus H. Kenyon and Seymour Taylor. The officers are as follows: President, J. Edward Howland; vice-president, Marcus C. Allen; secretary, Grenville M. Ingalsbe; treasurer, Charles T. Beach; committee on electrical control, Directors Ingalsbe, Beach and Taylor; purchasing committee, Director Allen.

The Dominion Telegraph Company held its twenty-third annual meeting of the shareholders in Montreal recently. The directors reported that the annual rental of six per cent., as well as the interest semi-annually of six per cent., payable by the Western Union Company, had been duly paid for the year 1891, and promptly distributed among the share and bond holders of the company and that the company's lines operated by the Western Union company and the Great Northwestern company had been efficiently operated by these lessees. The financial statement for the year 1891 showed the balance at the credit of the profit and loss account to be $6,758.04; capital stock paid up, $1,000,000; cash on hand and in bank, $31,873.47. The following gentlemen were elected as directors for the ensuing year: Thomas Swinyard, Hon. F. Smith, H. S. Northop, Alexander T. Fulton, Gen. Thomas T. Eckert, E. Wiman, Charles A. Tucker, A. G. Ramsay and Henry Bellatt. Mr. Swinyard was reappointed president, Hon. Frank Smith vice-president, and Fred Roper secretary of the company.

Special Correspondence.

NEW YORK NOTES.

Office of The Electrical World,
167-177 Times Building, New York, Feb. 15, 1892.

Mr. Robert McA. Lloyd will deliver a lecture before the Brooklyn Institute, department of electricity, Feb. 19 on "Accumulators."

The East River Electric Light Company has been granted permission by Judge Beach, of the Supreme Court, to change its name to the Thomson-Houston Electric Company, of New York.

Mr. James M. Lewis has been appointed general agent for the Security Insulator Company, and has taken offices at 136 Liberty street. He is a gentleman well known in financial circles, and we predict for him every success in the new field which he has entered.

Lower Broadway Clear of Poles.—The lower part of Broadway has been divested of its last telegraph poles and wires by the United Electric Light and Power Company. There is now a clear, unobstructed view from Bowling Green to Grace Church, without a single unsightly pole to mar the prospect.

The Board of Electrical Control.—The question as to whether the board will be discontinued or not this year is unsettled as yet. Commissioner Storm is of the opinion that the commission will have to be continued by the Legislature at least for another year in order that the immense number of applications for electric light and subway privileges may be properly attended to.

The Metropolitan Telephone Company suffered some considerable loss by fire in the Eighteenth street exchange last Saturday evening. Several electricians and a number of workmen were engaged Sunday arranging the circuits that were temporarily cut off by the fire and connected nearly two-thirds of the wires with the exchange and will probably have all the connections completed to-day. The new switchboard, which was recently put in at a cost of $200,000, and which it was feared had been badly injured by the fire, was not materially damaged.

The Proposed System of Electric and Pneumatic Tubes for the rapid transmission of mail from New York to Brooklyn, was given a hearing before a sub-committee of the House Post Office Committee a few days since in Washington. Representative Clancey, of Brooklyn, and Postmaster George Collins of that city appeared before the committee with reference to Mr. Clancey's bill providing for an appropriation of $95,000 for improving the mail service between this city and Brooklyn. Reference to this bill was made in The Electrical World a few weeks since.

The Electric Construction and Supply Company, of 18 Cortlandt street, has just placed on exhibition in its show rooms a new theatrical lamp. It is designed to fill the place occupied by the calcium light, and has all the prominent features which have made the calcium light so desirable. It can be used by simply connecting with the electric arc lamp in the regular lighting circuit, the same as an incandescent lamp. The lamp is handsomely finished in brass, and is adjustable to any position. When burning it gives a mellow light, absolutely steady and free from noise. The stand and lamp as mounted for service are strong and compact. It is easily handled, not requiring an expert, and its economy is apparent, usually consuming 10 ampères only, although greater candle power can be had if desired.

Lincoln's Anniversary at the Electric Club.—On Friday night of last week the members and guests of the Electric Club were treated to a delightful account of Mr. A. B. Chandler's personal reminiscences of Lincoln. Mr. Chandler, who is now the president of the Postal Telegraph Cable Company, was a military telegrapher during the Civil War and occupied a position in which he was often brought in personal relations with President Lincoln. His anecdotes were much enjoyed by the unusually large attendance of the club's membership. Mr. Holloway, the president of the Engineers' Club, of this city, who was also personally acquainted with Lincoln, gave some reminiscences of their friendly relations. General O'Beirne, the Commissioner of Immigration, who was present at the death of President Lincoln in 1865, gave those present an interesting account of that important event in the history of the United States. It was agreed by the members that this was one of the most enjoyable of the club's winter meetings.

Mr. Chas. E. Emery, 915 Bennett Building, New York, has sent out a circular letter to engine builders in different parts of the country in regard to the revision of an article which was written by him on the "Cost of Steam Power," and which was published in the Transactions of the American Society of Civil Engineers in November, 1883. Mr. Emery has decided to revise the article, and will make a comparison of the relative cost of power in engines of different makes, and will also consider the different prices of fuel and the conditions as to continuous or occasional use. In his circular letter, referred to above, he requests information from engine builders in regard to each type of engine which they regularly manufacture, such, for instance, in a general way, as simple engines, condensing or non-condensing, fast or slow speed; compound engines, condensing or non-condensing, fast or slow speed, and triple compound engines, condensing or non-condensing, fast or slow speed, cost price, setting up, etc., and of fuel used.

Test of a New Electric Car.—A test of a new multiple distributing station system for electric street railway propulsion was made on Saturday afternoon last on the tracks of the Coney Island and Brooklyn Railroad Company. The system does away with all overhead wires, while at the same time having all the power of the trolley. A number of gentlemen interested, including C. C. Bowen, J. S. Zerbe, Bridge Superintendent Martin, Register Kenna, Superintendent Sullivan, of the Coney Island and Brooklyn Railroad, and Joseph Sacks, an electrician, went to Coney Island on a trolley car, and there witnessed the workings of the system. Between the tracks metal plates 6 × 8 inches were laid, projecting about three-fourths of an inch above the ground. These plates or "heads" were 12 feet apart, and had no connection above ground, but each one was connected by an underground wire with a distributing station. Several tests were made to show that there was no danger in touching the plates or the track.

Tribute to Mr. George Worthington.—At a meeting of the members of the Electric Club, held at the club house Friday evening, Feb. 12, the following minute was ordered to be spread upon the records of the club: "The Electric Club of New York hereby expresses the profound sorrow felt by its members upon learning of the death of Mr. George Worthington. His genial companionship, his hearty good will, never failing toward any, his disinterested friendship, his utter unselfishness endeared him to all who came within the circle of his acquaintance. The memory of these traits of his, as well as of his manly independence and courage, leaves in our minds and hearts the gracious sense of past comradeship to temper the sad knowledge of our friend's departure. He was one of the founders of this club, and the leading spirit in the work of building it up to usefulness and for the benefit andpleasure of its members. The secretary is requested to communicate this minute to the family of Mr. Worthington."

The Telephone Subscribers' Association, which was organized by the Board of Trade about two years ago, it is stated, is preparing to take active measures against the Metropolitan Telegraph and Telephone Company in the Legislature. The association was formed to secure the passage of a bill for the reduction of telephone charges, and its first bill was introduced in the Legislature of 1890, and made an arbitrary cut in rentals. It was, however, defeated, and last year a different bill was drawn up which provided for the appointment of a commission to investigate the subject of telephone charges with a view to the establishment of an equitable and reasonable rate, but the bill was defeated. At that time telephones in New York City cost $150 a year, and the company in six years earned returns amounting to $2,843,454.53 on an original investment of $600,000. Among those who are interested in having a bill introduced at this session of the Legislature are: James Talcott, C. C. Shayne, George L. Pease, of Boorum & Pease; William D. Stewart, of the Stewart Ceramic Company; Simon Sterne, Silas M. Giddings, of Oxley, Giddings & Enos; H. H. Brockway, of the Ashland House; David Hirsch, of the Defiance Cigar Factory, and William Irwin Martin, of Raynor & Martin. The secretary of the association is Frank S. Gardner, of 55 Liberty street.

The Consolidation of the Edison & Citizens' Electric Lighting Companies, of Brooklyn, and how the possible consolidation of the Edison General Electric and Thomson-Houston companies may affect the two Brooklyn companies, is a question just now of moment to those interested in Brooklyn. The Edison Electric Illuminating Company derives its charter, procures its machinery and obtains the local right to use the Edison inventions from the Edison General Electric Company. The Thomson-Houston company has given charters and provided machinery for two companies, the Citizens' Electric Light Company and the Brooklyn Municipal Electric Light Company. The Edison and the Citizens' are in direct competition, and there has been considerable rivalry between the two, as the Edison company was compelled to put all its wires into subways, involving a great outlay of money, and the law has never been applied to the Citizens'. Under Edison's patents the Edison company claimed a local monopoly for incandescent lights, but the Citizens' company commenced furnishing them to customers. The Edison retaliated by supplying arc lights. It is regarded, however, that the consolidation of the general and parent companies will unite all the competing local companies, and the Edison and Citizens' will hold their charter from the united general company, which also will control, as they now separately own, one-third of the capital stock of each, as it would be against the interests of the consolidated general company to permit the competition between its local companies throughout the country to continue.

L. H. H.

PHILADELPHIA NOTES.

Branch Office of The Electrical World,
927 Chestnut Street, Philadelphia, Feb. 13, 1892.

The Cutter Electrical and Manufacturing Company has several large orders for flexible lamp cords.

T. Yearsley, who makes a specialty of second hand motors and supplies, reports business all that can be expected.

The Fottrell Insulated Wire Company is now in a position to handle orders for its goods in any quantity.

Mr. J. T. McIntyre, representing the Electrical Engineering and Supply Company, of Syracuse, N. Y., was in the city recently.

Jas. J. Murray & Co., manufacturers of all descriptions of glass work for electrical purposes, report meeting with a good demand for specialties of the kind.

Rutherford & Barclay, manufacturers of the Rutherford Metallic Paint, report that business with electric light stations is rapidly assuming large proportions.

J. Elliott Shaw, the sole manufacturer of the Norway Iron frame electric bell, reports business as much improved, and the prospects for future business bright.

The Weston-Wells Manufacturing Company is making a specialty in the wire line of an incandescent lamp protector, for service when a protected lamp is needed.

Vallee Bros. & Co. are the sole manufacturers of the well-known Warrill Insulating Joint and the Warrell Fuse Block, beside handling a general line of electrical specialties.

The Thomson-Houston Electric Company has just completed a marine plant on a police boat at Baltimore, Md., consisting of a 6,000-c. p. naval projector, 20 incandescent light dynamo and Corless engine.

The Harrisburg Foundry and Machine Works, for which Mr. Frank Johnson is the Philadelphia agent, with offices in the Builders' Exchange, reports business in this territory as being exceedingly good.

The Philadelphia Post Office is to receive six of the electric postmarking labor-saving machines. It is expected that these will cause a reduction of the present force and will greatly expedite the business of the office.

Mr. Alfred F. Moore, whose business is the oldest established of any in the insulated electric wire business, having been founded in 1820, has made for himself a reputation which is a guarantee of satisfaction to the trade. He is the originator of fine coverings for wire for field magnets and armatures of dynamo machines, and the excellence of these goods has done much to insure the success of many electric light companies.

The Brush Electric Light Company and the Manufacturers' Electric Light Company were granted increased privileges at a recent meeting of the City Council. Ordinances have also been passed granting permission to the Columbia Electric Light Company, the Northern Electric Light Company and the Frankfort Avenue Merchants' Electric Light Company to extend their overhead and underground lines, etc.

To Be Executed.—There are few Philadelphians who have not noticed at one time or another the flock of sparrows which seem to have taken possession of the old tree of the Baldwin estate on Chestnut Street, above Eleventh. It will be of interest to know that there is a scheme on foot to so electrify this tree that some night the little sparrows will be given the benefit of an electrical shock that will make their death sudden but sure. It is proposed to use their bodies as food for the snakes at the Zoo.

A feature of illumination never before attempted in the Academy is the lighting of the foyer and the corridors of the balcony by electricity. Gas has always been the agency through which light was disseminated in the building, and Tuesday evening marked the first introduction of the electric spark as a means of illuminating the Academy. There were over 300 lamps shedding forth their brilliant lights. The twelve chandeliers in the foyer were set with circles of incandescent lights, some of which were enclosed in pink-tinted shades, which gave a beautiful effect. Out on the balcony corridors the chandeliers were also set with incandescents, which threw brighter rays than had ever before been seen within the building.

Chief Walker, of the Electrical Bureau, has submitted his report for 1891 to the Director of Public Safety, in which he renews and emphasizes his recommendation that the city should own its own electric plant and conduits, and that the wires should be put underground, and states that "the experience of the bureau has demonstrated the fact that under such conditions successful insulation is a certainty." Overhead wires for light and power he considers extremely dangerous, and he objects to a vast and increasing network of wires overhead. The Electrical Department has always been anxious to secure appropriations for putting its wires under ground. The report shows that many thousand feet of telegraph, telephone and electric light wires have been put up and put down during the year on many streets of the city and that a nucleus has been formed for extensive trunk lines in the future. The report enters into detail as to the number of feet of wire put down and conduits laid, one of the principal items being the 38,982 feet of wood and iron conduits put under ground by the Penn and Edison companies for the use of the city. In police telegraphing there was an increase of 21,582 messages over the number delivered in 1890. New patrol signal boxes have been put up in a number of the districts. In many institutions metallic circuits are to be introduced as rapidly as possible. The inspection of the fire alarm wires made during the year showed that many of them were faulty, and they have since undergone thorough repairs. The total number of electric lights belonging to the city is reported as 1,781, inclusive of the fifty lights maintained by the Girard Trust on Delaware avenue and Front street. Of the $144,358.45 appropriated for 1891 the bureau has expended $141,249.58; carried over to meet contracts, $2,563.11, and permitted to merge, $545.76. Of the poles now standing on the streets the city owns 7,452, and 12,982 are owned by the corporations.

W. R. W.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 28, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., Feb. 13, 1892.

Mr. C. F. West, of Concord (N. H.), connected with the Thomson-Houston Company, was in town on Thursday.

Members of the Engineering Corps of the Northern Pacific and the Wisconsin Central Railroad are studying electrical science at the Institute of Technology, by direction of the management of the Northern Pacific.

Clinton, Mass.—The selectmen gave a hearing recently upon the petition of the directors of the North End Street Railroad Company of Worcester in regard to a contemplated extension of its lines from Worcester to Clinton.

The "Beacon" lamp is holding its own, if large orders are any criterion, and judging from the reports of those using the lamp they are to be congratulated in being able to turn out a lamp which is certainly all they claim for it.

Flexible tubing is manufactured by the American Circular Loom Company, of Boston. This company reports an active business in its regular line of "Canvas Jacket," and is about to introduce a new product in the shape of tubing for underground and marine work.

Mr. S. E. Barton, formerly president of the Electric Mutual Insurance Company, of Boston, has been appointed secretary of the Lancashire's new American department. Mr. Barton is a gentleman whose familiarity with insurers and experience with underwriting will guarantee his success in his new field of labor.

The Eastern Electric Supply Company, of 65 Oliver street, Boston, has secured the contract for building the new Worcester & Shrewsbury Electric Railway, which will be four miles in length. They are to furnish everything. The new line of Winton insulation material which has attracted so much attention of late will be used on this road.

The New England Butt Company, of Providence, reports a very favorable showing for the past year with the prospect of a largely increased business for this year. The reputation this company has had in the past for turning out braiding machines and castings of a high class will not be allowed to lag in any particular, and many improvements are contemplated for the near future.

A New Electrical Industry may possibly be located in Lowell. Capitalists already interested in a company which is doing a business of $100,000 per year in Boston desire to change its location to Lowell for the manufacture of electrical machinery, dynamos, motors, etc. It is possible a stock company capitalized for $250,000 may be formed. Local capitalists are being solicited for a subscription of $100,000.

Claflin & Kimball, of Boston, have removed their offices from the fourth floor to the top floor of the Shoe and Leather Building 114-120 Bedford street. In making this change they secure the whole of the latter floor with an additional large room finished off above for the use of draughtsmen, etc. The new quarters are light and airy, and are where all the business of the Mather Electric Company and the Perkins Lamp Company (except the actual manufacturing) will be transacted in the future.

The Thomson-Houston general officers, and vice-president Coffin, together with several superintendents from the Lynn factories have visited the Edison factory at Schenectady. The Thomson-Houston company has sent out circulars to its stockholders, advising their assent to the consolidation agreement with the Edison General Company, and it is stated that the matter will probably be closed up in a short time, as the agreement is being rapidly signed in New York, Boston and Lynn, and it is thought that the majority of the stock of both the Thomson-Houston and Edison companies will have signified its assent within a few days.

A possible consolidation of leading fire alarm and police signal manufacturing companies is reported. The Boston *Advertiser*, in a recent issue, states, "for the past two years Col. E. M. Graves, of Hartford, Conn., acting as agent for Waller, Cook & Wagner, of New York, has been working for the consolidation of the various fire alarm and police signal manufacturing companies of the country. Eighty per cent. of the companies have formed a combination, with a capital stock of $1,000,000, and formally organized by electing Gen. E. S. Greeley, of New Haven, president, and Col. Graves, secretary. It is proposed to consolidate the business of all the factories under one roof. At the present time the Gaynor Electric Company, of Louisville, is the largest concern in the country, but when all are consolidated about 500 hands will be needed. The main offices of the combination will be located in New York, and the factories will be located in the East. An effort will be made to locate in Hartford, provided suitable arrangements can be made." C. A. B.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
465 THE ROOKERY, CHICAGO, Feb. 13, 1892.

Mr. J. H. Parker, of Boston, lunched with Mr. George Cutter at the Electric Club on Monday.

The new telephone number system has been put in operation and seems to be working satisfactorily.

The Detroit Motor Company has placed Mr. Channing T. Gage, formerly of Detroit, in charge of its Chicago business with headquarters at No. 320 The Rookery, where general sales-agent Armour will also be found.

Mr. R. J. Randolph, of 427 The Rookery, Chicago, is the chairman of the Citizens' Committee of Rogers Park, Ill., and will furnish specifications for proposals for lighting that village with arc and incandescent lamps.

The Canton Steel Roofing Company, of Canton, O., is desirous of entering into correspondence with central station managers who contemplate using steel roofing or siding, either in repairs or in new stations, and to all who are interested in the subject it will send pamphlets and samples.

Mr. F. W. Weir, late manager of the Chicago office of the Falls Rivet and Machine Company, is now representing the Saginaw Manufacturing Company, of Saginaw, Mich., and will probably have an important specialty on exhibition at the National Electric Light Convention at Buffalo that will prove of interest to central station managers.

Mr. William O. Garrison, vice-president of the Columbia Incandescent Lamp Company, St. Louis, and a representative of the Illinois Steel Company, was in Chicago on Friday. Mr. Garrison has just returned from an extended pleasure trip along the Pacific slope, and was favorably impressed with the prospects for a good season of business prosperity in the far West.

Mr. William D. Ray, electrician of the Chicago & Northern Pacific Railroad Company, with headquarters at Chicago, is sending to his friends a dainty little souvenir of the big depot on Harrison street and Fifth avenue, in the form of a most charming description of the artistic features of that veritable palace for the weary traveler compelled to await the arrival of a late train.

J. J. Ryan & Co., brass founders and finishers, who have the largest jobbing brass foundry in the West at No. 68 to 74 W. Monroe street, Chicago, have been crowded with work during the entire season, both in brass castings and in aluminium castings and aluminium brass castings. Many of the parent companies and supply houses secure all their castings from this foundry, and it is worthy of note that the work turned out has given universal satisfaction.

The Illinois Electric Lamp Company, 171 and 173 South Canal street, Chicago, suffered a loss of about $1,000 by explosion and fire, which occurred on Wednesday, in the new building in which they were so thoroughly equipping their factory. Warren Springer owns the building, a double floor of which they have leased for a term of years, and Superintendent Schaefer in referring to the matter said: "This may delay us a month or so, but we shall endeavor to get in shape as quickly as possible, and shall then have the finest and most completely equipped incandescent lamp factory in the world." F. DE L.

News of the Week.

THE TELEPHONE.

Telephone Extensions.—The Sunset Telephone and Telegraph Company will spend $160,000 on extensions in the State of Washington this year. A new line will be built from Seattle to Snohomish and Everett, work to begin immediately. A new copper wire line will be built between Tacoma and Seattle, and a line to Bellingham Bay is contemplated. A line to Portland, Ore., is also likely to be built, connecting with a number of small towns along the route. These extensions will enable people in Western Washington to converse from the British boundary to the Columbia River.

THE ELECTRIC LIGHT.

Boonville, Ind.—The town is to be lighted by electricity.

Negaunee, Mich., now has an all night electric light service.

Newaygo, Mich.—It is reported that this town will soon have electric lights.

The Dallas (Ore.) Electric Light Company will add an extensive three-wire system to its arc plant.

Eugene, Ore.—The Eugene Electric Light Company will replace at once the two houses of its plant which were recently destroyed by fire.

Carrollton, Mo.—The proposition to extend the franchise of the Light, Heat and Power Company was defeated at a recent special election.

Marshfield, Ore.—Messrs. Carlson & Dame have established and placed in operation an electric lighting plant of the Thomson-Houston system.

Lewiston, Idaho.—Bids for arc lighting have been called for, the plant to be in operation by July 1. The bids were called for by J. M. Howe, City Clerk.

Springfield, Ore.—A company has been formed and articles of incorporation filed for the purpose of building and operating an electric lighting system in this place.

Washington, D. C.—The House has passed the amendment to substitute electricity for gas at the West Point Military Academy and $9,500 is appropriated for the purpose.

Lebanon, Ore.—A company composed of J. L. Cowan, Frank O'Neill and L. Foley has been granted a franchise for the period of 15 years for establishing a complete system of electric lights.

Mobile, Ala.—The New American Arc Light Company, of Washington, D. C., has filed with the Mayor and City Council a proposition to furnish the city with a complete electric light plant for the sum of $43,750, and agree to operate and keep the plant in repair for one, three, five, or ten years, for $10,000 per annum.

Grand Rapids, Minn.—An injunction has been granted against the Grand Rapids Water Power and Light Company, recently incorporated, which was granted a thirty-year electric light contract, that calls for $2,700 a year for ten years for supplying thirty incandescent lights of 50 c. p. The injunction has an order to show cause and is to be heard March 18.

New Electric Plant.—The representatives of the Sharon estate in San Francisco are completing a new electric plant on the northwest corner of Mission and New Montgomery streets, adjacent to the Palace Hotel. It is proposed to generate electricity for the Palace Hotel, the building having been wired for that purpose, and it is expected to light the rooms entirely by incandescent lamps.

The Haverhill (Mass.) Electric Light Company is making extensive additions and improvements to its plant and by July it is stated, will have one of the most extensive and complete plants in the country for the production of light, heat and power. A new power-house is being erected. New engines and boilers will be put in with the exception of one 100-h. p. Ball engine, which will be removed from the present works of the company and used for hoisting and miscellaneous purposes. Three new engines will be built, 250, 350 and 400 h. p. respectively, to run the electrical machinery. The boilers will be eight in number, of 125 h. p. each. The dynamos now used by the company which are for operating arc and incandescent lights and running motors will be transferred to the new shop and new ones of equal capacity added as soon as the buildings are ready, which will double the productive power of the company. In addition to other purposes the company will be prepared to furnish power for street railway operation.

THE ELECTRIC RAILWAY.

The Negaunee & Ishpeming Street Railway Company, of Ishpeming, Mich., has put its electric street car line in operation between Negaunee and Ishpeming.

Indianapolis, Ind.—Citizens of Brightwood, a suburb, have subscribed $10,000 to be donated to the Citizens' Street Railway Company to build an electric line to that place.

The West Haven (Conn.) Railroad Company, contemplates equipping its lines electrically, it is reported, and will, it is stated, petition the Council for authority to do so.

The Central Passenger Railway Company, of Baltimore, Md., which recently applied to the City Council for authority to use electricity on its lines, is to increase its capital stock and be reorganized.

Plainfield, N. J.—A bill has been introduced in the New Jersey Legislature "legalizing" the action of the "Big Six" Council which granted a franchise for a trolley system to a company of Essex county capitalists last year.

The Peachtree Electric Street Railroad Company, of Atlanta, Ga., recently incorporated by H. L. Harrison, P. Harrison, D. C. Bacon, M. F. Amorus, P. B. Lawrence, W. S. Turner and B. L. McIntosh, it is stated will begin construction at once.

The Seashore Electric Railway Company, of Asbury Park, N. J., it is reported, contemplates removing its tracks and leaving the town, unless granted an extension of its franchise for fifty years by the Borough Commissioners. Negotiations are pending looking to a satisfactory arrangement between the company and the commissioners.

The Calumet Electric Street Railway Company, of Chicago, has filed with the City Clerk its acceptance of the ordinance of Jan. 18, granting it a franchise for extensions of its lines. A bill has been filed in the Circuit Court by Perkins Bass asking that a restraining order be granted against the company from constructing and operating its lines on certain streets, claiming that the necessary consents of property holders have not been obtained.

The Jefferson Park & Chicago Electric Railway, of Chicago, has obtained the right of way to operate an electric street car line on Elston avenue from Jefferson Park to Addison street, and from that point east to Southport avenue, where it will connect with the Chicago & Evanston Electric Railway, which will run between Chicago and Evanston. The promoters of this enterprise are E. E. Gordon, W. W. Lowe, J. H. McAllister, George R. Allen and Frederick H. Doty.

EDUCATIONAL NOTE.

The Worcester Polytechnic Institute, of Worcester, Mass., at a recent meeting of the board of trustees, voted to establish a new undergraduate department in electrical engineering.

PERSONALS.

Mr. Emile Kolben, Chief Engineer of the Schenectady Works of the Edison General Electric Company, has resigned, and sailed for Europe Saturday last on the La Normandie, to accept a position with the Oerlikon Works at Zurich.

Mr. W. F. Holloway, traveling representative for the Aluminium Carbon Company, of Buffalo, N. Y., is spending a few days at the company's factory at Lancaster, N. Y. He reports very satisfactory sales in his territory.

Mr. Gilbert Wilkes has resigned his position as district engineer of the Eastern district of the Edison General Electric Company, to take effect March 1, in order to take charge of the electrical work at the Detroit Electrical Works as their chief engineer.

Joseph A. McClary, for several years manager of the largest branch of the Postal Telegraph Company in New York City, and who was recently appointed general manager of the New Jersey Postal Telegraph service, was given a pleasant surprise at his home in Rahway, N. J., on Saturday evening of last week, by his former employés of the New York office, who presented to him a beautiful marble clock surmounted with a bronze figure. The presentation speech was made by Mr. Hamilton, of Newark. The visitors numbered about fifty.

Industrial and Trade Notes.

The Standard Fibre Ware Company, of Mankato, Minn., is sending out an unusually attractive calendar for 1892.

The Hobart Electric Company, of Middletown, O., has closed a contract with the P. J. Long Tobacco Company, of Middletown, for two 250-h. p. 500-volt generators and eight 500-volt motors to aggregate 100 h. p., to be installed in the new factory which the company has erected.

The Electric Appliance Company, of Chicago, reports that the demand for C. E. M. sockets is so great that the factory is getting behind on its orders. This is regarded as a high testimonial as to the popularity of this socket, which has had many tests of its efficiency and is extensively used.

Peerless Oils.—Geo. P. Jones Company, the well known western oil house, in St. Louis, have added another of the great central stations to the growing list of customers who, having put the Peerless cylinder and dynamo oils to a practical test, have adopted same on the ground of efficiency and economy.

The Chester Pipe and Tube Company, of South Chester, Pa., has placed a contract for its new building with the Berlin Iron Bridge Company, of East Berlin, Conn. The building will be 52 feet in width by 170 feet long and constructed entirely of iron, no wood work being used about the construction.

The Crocker-Wheeler Motor Company is building a special motor, to be used in connection with the Kinsman system of refrigeration. The motor when in use is really turned upside down, the shafts projecting from either end, and on these are arranged a set of saws which continually cut the ice into all desired sizes.

The St. Louis Electrical Supply Company, of 809 Locust street, St. Louis, Mo., are not only the special agents for the Packard incandescent lamps, Grimshaw white core insulated wires and tapes, K. K. line wires, and for Wagoner's motor for alternating or direct current, but are also headquarters for all dynamo and electrical supplies of whatever nature, and report an unusually good winter trade.

Alexander, Barney & Chapin have made arrangements for enlarging their business and will extend their electric railway supply department. To accomplish this the corporation recently voted an increase in its capital stock. We are informed that outside of the present holders of stock several parties interested in electrical business have recently subscribed for part of the new issue.

Messrs. Hall & Godfrey, of Bridgeport, Conn., have just finished building a novelty in the line of a truck, the idea of Mr. W. R. Brixey, superintendent of the Kerite wire factory. The truck is called the "Ozonator," and has a freight capacity of 35 tons Kerite wire. It is made after the order of London trucks, and will be used between their factory and the depot at Seymour, Conn. When loaded it requires 20 horses to pull it.

The Nassau Electric Specialty Company, 112 White street, New York, is meeting with great success in the sale of its four cell handy case. It has had a special demand from mines and mining foremen, who have found it very handy in blasting purposes. There is complete control of the battery until the charge in any blast is ready to be fired. The Midget faradic battery, also manufactured by this company, has also been favorably received.

The Hine Eliminator Company is in receipt of letters from H. S. Carhart, of the Michigan University, Ann Arbor, also from A. P. Carman, of Pardue University, Lafayette, Ind., professors of physics and electrical engineering in these institutions, in which they speak, it is stated, in the highest terms of the Hine eliminators attached to the main steam pipes leading to the dynamo engines in their respective departments for obtaining dry steam.

The Electrical Supply Company, of Chicago, has issued a neatly printed and illustrated circular describing a few of its elec-

trical testing instruments, which calls particular attention to the Wirt volt-indicator as being extremely simple and reliable. This instrument, it is said, contains neither springs, permanent magnets, hot wire device, multiplying gear, sliding resistance, carbon resistance, knife edges, contact points or any similar devices.

The St. Louis Electrical Supply Company is sending out a perfect gem of a wall calendar, probably the most beautiful of its type produced this season. The four females that cluster around the figure of Columbia, representing the four corners of our country, are not only tastefully robed, but possess unusually clear cut and attractive features, while the little Southern maid has an armlet the jewels of which form the symbol of Ohm's law, that lends additional charm to the artistic piece of harmonious color work.

The Storage Battery Supply Company, of 120 Broadway, New York City, is a company which recently started in business in this city, and is composed of T. D. Bunce, Jr., and R. S. Voorhees. They are sole agents of the Consolidated Electric Storage Company, of New York City, and supply equipments of all kinds for phonograph, dental and surgical use, decorative effects, fan motors, etc. They manufacture a portable electric lantern which is being extensively used by the Standard Oil Company for safety purposes, and which is a very ingenious arrangement in the line of portable electric lamps.

Pettingell, Andrews & Co., of Boston, whose name is so familiar to central station men throughout the New England States, are making a grand success of their new "PA" weatherproof wire. Wherever it has been used it has been received with great favor. Among the recent sales are 20,000 pounds to the Salem (Mass.) Electric Light Company and the equipment of the new plant at Milford, N. H. Pettingell, Andrews & Co. are at present at work on a new catalogue setting forth the merits of their house supplies, in which line they have recently opened a special department made necessary by their increasing trade.

Business Notices.

The Mather Electric Motors combine the highest efficiency and workmanship consistent with a reasonable first cost. Perfect automatic regulation of speed from no load to full load. For catalogues and information address E. T. Pardee, agent, 14 Butler Block, Syracuse, N. Y.

A Central Station Plant for Sale.—Parties desiring to secure a well established central station plant in a prosperous town in central Illinois should read the "for sale" notice in our advertising columns, headed "An Excellent Opportunity." The sole reason for selling is the continued ill-health of the proprietor's family, necessitating removal to Southern California.

The National Electric Light Convention, Buffalo, Feb. 23 to 26.—Are you aware that the next meeting of the National Electric Light Association will be held at Buffalo, Feb. 23 to 26, and will be one of the most important in the history of the association? Owing to the importance of this meeting the railroads throughout the East and West will grant low rates, and the Michigan Central. "The Niagara Falls Route," in addition to making a rate of $18 from Chicago to Buffalo and return, announce that they will have special cars attached to their New York vestibuled express, leaving Chicago at 3:10 P. M., Monday, Feb. 22, arriving in Buffalo early the next morning, for the use of delegates and others going from the West. Applications for space should be made as early as possible to Mr. L. D. Heusner, passenger and ticket agent, Michigan Central Railroad, No. 67 Clark street, Chicago, who will also issue tickets at the low rate announced. It should be understood that this low rate is applicable to all who desire to attend, including delegates, members of their families or supply men.

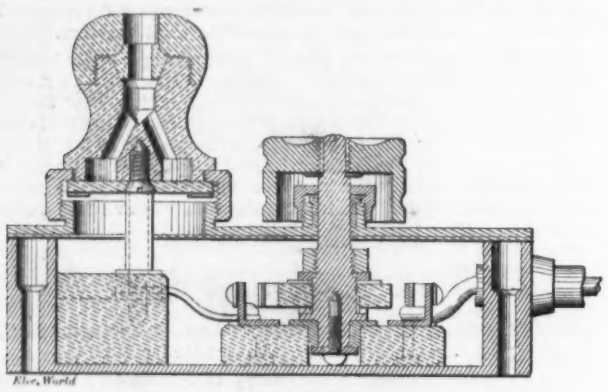
Delegates to the Annual Meeting of the National Electric Light Association at Buffalo will leave Chicago Monday afternoon, Feb. 22, and arrangements are being made for conveying them in special vestibuled sleeping cars attached to the 3:10 P. M. train of the Lake Shore & Michigan Southern Railway, arriving at Buffalo at 7:20 Eastern time the next morning. Any who find it more convenient to leave later can take the limited at 5:30 P. M., arriving at 9:40 A. M., Eastern time. Of the half dozen daily trains returning, the most convenient leave Buffalo at 11:50 A. M., 7:20 P. M., and 11:08 P. M., all Central time, arriving in Chicago respectively at 7:35 A. M., 9:30 A. M. and 3 P. M. the next day. It will be seen from the above the trip by this route, in either direction, may be made in a single night's travel, an advantage over any other line of half a day's time saved on the return journey alone. Tickets for the round trip, $18 on the certificate plan; berths, $3 each way; $1 extra going on the limited. For reservations, certificate, and any information address John L. Martin, of Committee on Transportation, care of Chicago Electric Club, Chicago; or C. K. Wilber, W. P. A., Chicago.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

U. S. PATENTS ISSUED FEB. 9, 1892.

468,388. Elevated Electric Conduit; Charles O. Newton, of Homer, N. Y. Application filed Dec. 18, 1889. An elevated support for electric wires, having a platform, a central inclosure on the platform and footways at the sides of said inclosure, and a passage within the inclosure separate from the wireways also within the inclosure.

468,411. Carbon Holder for Arc Lamps; Samuel P. Parmly, of Chicago, Ill. Application filed Sept. 30, 1890. The combination of a carbon rod with a carbon holder, the two connected by a swivel joint, said carbon holder provided with two



No. 468,474.—Combined Switch and Switch-Box.

channels and a thin separating rib, so as to receive two carbons side by side, and a clamp to simultaneously grasp and hold the two carbons in position.

468,412. Arc Light Globe Holder; Charles A. Pfluger, of Chicago, Ill., Assignor to the Standard Electric Company, of Illinois. Application filed April 6, 1891. The combination of a movable globe holder with two rods downwardly depending from the lower carbon support and passing through the holder, and securing devices whereby such holder is adjustably secured to the rods, and a removable rest at the lower ends of such rods to receive the globe holder.

468,413. Arc-Light Hanger for Inside Use; Charles A. Pfluger, of Chicago, Ill., Assignor by direct and mesne assignments to the Standard Electric Company, of Illinois. Application filed May 15, 1891. In an arc-light hanger for interior use, the combination of a support with a lamp, hooks on such support to sustain the lamp, and oppositely acting springs, which tend one to raise the lamp, and the other to force it downwardly and hold it in the hooks.

468,416. Dynamo-Electric Machine; George Edeusor Dorman, of Chicago, Ill., Assignor to the Standard Electric Company, of Illinois. In a multipolar dynamo machine, a cross connecting device consisting of a drum within the armature, the drum having thereon a series of insulated rings, each ring provided with a series of bars connected to its outer edge and running parallel with its axis, securing bands which pass longitudinally about the rim of such drum, and securing the rings and surrounding rings which pass about and secure the bars.

468,426. Electrically Heated Smoothing Cylinder; Willis Mitchell, of Malden, Assignor to the Butterfield-Mitchell Electric Heating Company, of Boston, Mass. Application filed May 26, 1891. In an electrically heated smoothing device, a cylindrical heating body of magnetic metal provided with studs or cores, in combination with an electrical conductor forming part of an electric circuit, and wound in helices about the said cores for heating by resistance and magnetization.

468,336. Trolley Wire Support; Jonathan P. B. Fiske, of Lynn, Mass., Assignor to the Thomson-Houston Electric Company, of Connecticut. Application filed July 30, 1891. A trolley wire support having an ear or hanger extending along the top of the wire, a sheet metal clip extending below and embracing the trolley wire and having end portions projecting above the wire and hanger, and clamping devices engaging with the hanger and end portions of the clip.

468,451. Magneto-Electric Machine; John Hunt, of New York, Assignor to James Macbeth, of Brooklyn, N. Y. Application filed April 24, 1891. An electric generator comprising a portable box constructed with opposite foot-rests upon which the operator may stand, a magneto-electric machine inclosed in the box, a pull-up operating handle above the latter, a vertically movable connection passing from said handle through the top of the box, and mechanism connected thereto for imparting rotation to the armature of the magneto-electric machine upon pulling said connection upwardly, whereby the weights of the operator standing on said foot-rests and the reaction of his upward pull are utilized for holding the box down during the operating stroke.

468,473. Repeater for Electric Circuits; Moses G. Crane and Frederick W. Cole, of Newton, Mass. Application filed July 2, 1889. The combination of a number of main line electro-magnets, each in a main circuit independent of the others, with a lock-actuating bar and a number of locks connected therewith, one co-operating with the armature of each of the magnets, the lock-actuating bar being controlled by each of said armatures the locks being moved upon the retraction of any one of the said armatures and retaining all except the armature which was retracted in normal position for a predetermined period of time after said movement, at the end of which period the lock-actuating bar is moved and unlocks all the armatures.

468,474. Combined Switch and Switch-Box; Albert L. Rohrer, of Lynn, Mass., Assignor to the Thomson-Houston Electric Company, of Connecticut. Application filed Dec. 2, 1890. The combination of a switch-box, the switch contacts inclosed therein, but actuated by a handle outside the box, a cover secured to the box, elastic water-repellant sealing material interposed between the cover and box, and elastic bushings sealing the circuit-wires and switch-handle, where they enter the box. (See illustration.)

468,487. Electric Lighting System; Sylvanus L. Trippe, of New York. Application filed Feb. 25, 1891. The combination, with an electric generator and a series of two or more circuits, of a switch and transformer and an electromagnet both interposed between the generator. (See illustration.)

468,492. Electric Motor Truck; Francis O. Blackwell, of Boston, Mass., Assignor to the Thomson-Houston Electric Company, of Connecticut. Application filed Sept. 16, 1889. The combination, with axles of a truck, of an electric motor journaled upon one axle by bearings at its yoke end, a journal box on the opposite axle, and a supporting bar or frame extending from the upper pole piece and having a spring attachment to the journal box.

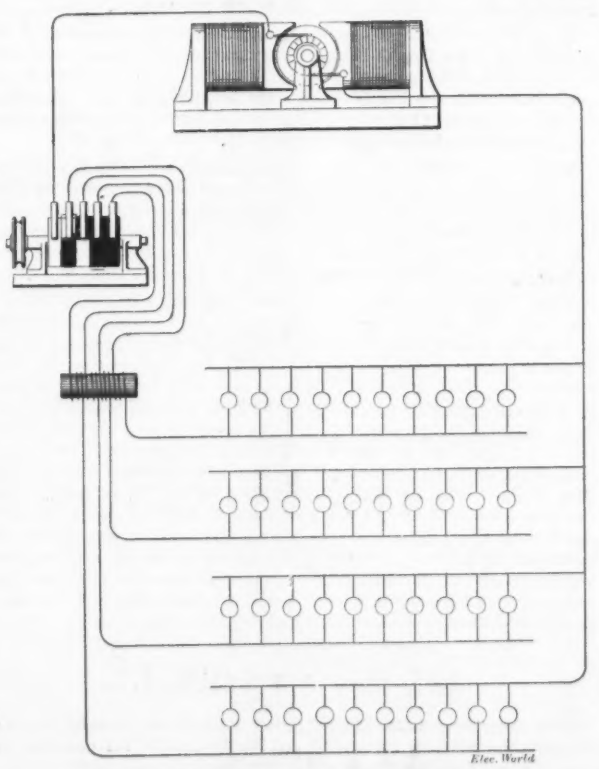
468,497. Lightning Arrester; Elihu Thomson, of Lynn, Mass., Assignor to the Thomson-Houston Electric Company of Connecticut. Application filed May 5, 1890. A lightning arrester consisting of a series of conducting particles supported in a form of plastic insulating material and arranged to form a succession of small disruptive spaces in the discharge path.

468,500. System for Operating Glow Lamps by Means of Multiphase Currents; Johannes Friedrich Görges, of Berlin, Germany, Assignor to Siemens & Halske, of same place. Application filed Sept. 3, 1891. A system for operating glow lamps by means of multiphase currents, which consists in a number of rotation current conductors corresponding to the number of phases of the current, any desired number of glow lamps, a number of current introducers to each lamp equal to the number of said conductors and connected to said conductors, and glow bodies at the interior of the lamp electrically connected to each other and to pairs of the said current introducers. (See illustration.)

468,525. Motor Gearing for Electric Cars; Elbert B. Phillips, of Cleveland, O. Application filed Jan. 6, 1891. The combination, with a car of a propelling motor, two sets of gearing for coupling the motor, and axle to drive the latter at different speeds and means whereby the power of the motor may be applied direct.

468,540. Ore Separator; Henry Cane, of Spokane Falls, Washington, Assignor of one-half to Walter Gerson, of same place. Application filed June 6, 1891. In a magnetic ore separator a magnetic drum, an endless belt and a supplemental guide pulley and a supplemental endless belt located between said guide pulleys and the main endless belt.

468,575. Electric Railway System; William J. Ogden, of Baltimore, Md. Application filed Nov. 20, 1891. In a double-track system for street railways, the combination of a single conductor centrally located between the tracks and having two contact edges and a width to permit two trolley rollers in contact with opposite



No. 468,487.—Electric Lighting System.

edges of said conductor to freely pass each other without contact between them and without leaving the conductor and arms hinged to the cars respectively, and each carrying a trolley roller which rests removably in contact with the conductor.

468,585. Electric Cable; William Vigler, of Somerville, Mass. Application filed March 7, 1891. An electric cable composed of a central insulated metallic core and surrounding fibrous threads and two or more wires arranged outside the said core substantially parallel to each other and separated by the threads, the latter wires and fibrous threads being interlooped or interwoven together.

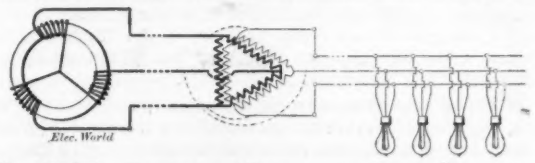
468,597. Electrical Indicator; Marion A. Deuel, of Rochester, N. Y. Application filed July 3, 1890. An indicator for indicating the condition of a telegraphic or analogous signaling line, consisting of a delicate magnetic needle suspended at one end in a non-magnetic frame or case secured to one of a main-line signaling instrument, the frame or case being provided with one or more transparent sides through which the needle may be observed.

468,599. Magnetic Separator; Erminio Ferraris, of Turin, Italy. Application filed March 13, 1891. A dynamo-magnetic wheel for separating by the aid of electricity different kinds of ores and metals, consisting of electromagnets mounted on the arms of the wheel, which magnets are in connection with each other and with a commutator of brushes, each of which is always in contact with two commutator elements, and of a wheel rim or crown enclosing the electromagnets.

468,654. Electric Connector; George Gibbs, of Milwaukee, Wis. Application filed Nov. 23, 1891. In a multiple electric connector, a member provided with conducting fingers, in combination with a second member provided with corresponding conducting fingers and with a clamping mechanism to bind the fingers of the two members forcibly together.

468,686. Electric Governor; John T. O'Brien, of Kearney, Neb. Application filed Feb. 9, 1891. In an electric governor, the combination of a solenoid provided with an armature, a circuit controller carried by the armature, a series of contacts arranged to be connected by circuit controller, resistances and translating devices arranged to be thrown into and out of the circuit by the circuit controller, the resistance and translating devices being made with like resistance to permit of alternating the translating devices and resistances without changing the total resistance of the circuit.

468,690. Ring Armature; John George Pool, of New Haven, Conn., Assignor by direct and mesne assignments of three-fourths



No. 468,500.—System of Operating Glow Lamps by Means of Multiphase Currents.

to himself, Joseph E. Hobinger and Nicholas W. Hobinger, of same place. Application filed Sept. 7, 1891. The combination with an annular or ring armature core, of a series of conductors or wire coils wound around the section of the ring and connected in endless or closed circuit with the successive coils alternated wound in opposite directions and arranged at intervals or radial spaces apart on the ring corresponding to the distance between neutral points of adjacent poles of the field magnets, the corresponding coils of successive cycles or sub series of conductors being disposed in uniform precession or recession, and commutator connections corresponding to the cycles or sub-series of conducting coils.

468,706. Magnetic Extractor; Horatio W. Southworth, of New York. Application filed March 11, 1891. In a magnetic extractor, the combination, with a helical channel, of a series of magnets having poles projecting into the channel.

468,708. Electric Railway; Charles W. Thomas, of Jersey City, N. J., Assignor of part to Philip Van Volkenburgh, of New York, and John H. Pendleton, of Brooklyn, N. Y. Application filed Oct. 21, 1890. The trolley has two contact sheaves journaled in a single rocking frame, which is fulcrumed in the trailer arm, one sheave pressing from above downward and the other sheave from beneath upward against the conducting wire or line. A spring is employed just balancing the weight of the trailer arm and its contact devices.

468,711. Electric Arc Lamp; Adison G. Waterhouse, of Hartford, Conn. Application filed Aug. 21, 1891. An electric arc lamp frame consisting of a cup-shaped top having side sockets for receiving lamp terminals, the lamp top and sockets formed so as to completely cover and surround the regulating mechanism belonging to the lamp and the lamp terminals, and an anchor plate electrically connected to one of the terminals, the anchor plate and terminals being embedded and rigidly secured in their places by means of said cement, which conforms and adheres to the inner surface of the lamp top and sockets.

468,716. Electric Motor; James T. Wilson, of Tyrone, Pa. Application filed Aug. 6, 1891. The combination, with a fixed frame and a reciprocating frame mounted thereon, of an electric motor having its armature shaft journaled transversely in bearings on the said reciprocating frame, and a crank and pitman connection between the armature shaft and the fixed frame.

468,752. Rheostat; Alton J. Shaw, of Muskegon, Mich. Application filed Oct. 15, 1891. In a rheostat, an integral bar or body constituting the resistance and a series of plates embedded in said bar at points between its ends and projecting therefrom at one side to form contact surfaces, the plates being of lower specific resistance than the body of the bar.

468,755. Telegraphy; William Frederick Wentz, of Newark, N. J., Assignor of one-half to Otto G. Hoerster, of same place. Application filed Feb. 14, 1891. In a telegraphic system, the combination, with a main line, including both terminal and intermediate stations and main batteries or generators, of means for reducing the current which is free to flow over the main line, and an electro-responsive apparatus controlling said means to make it operative when the main circuit is open. (See illustration on page 116.)

468,772. Insulating Coupling; Louis McCarthy, of Boston, Mass. Application filed Oct. 19, 1891. An insulating coupling for pipes comprising two flanged tubes, a layer of insulating material placed between the flanges thereof, and a series of securing bolts alternately set with reference to the said flanges and having their heads alternately engaging with the opposite sides of the said layer.

468,773. Insulating Coupling; Louis McCarthy, of Boston, Mass. Application filed Oct. 19, 1891. An insulating coupling having the coupling portions thereof separated by an interposed layer of insulating material, devices whereby the whole is secured together, and an outer layer or jacket of insulating material whereby the joint is covered and whereby, also, the space between the outer parts of the coupling portions is prevented from becoming electrically bridged.

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1886—can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y.